



COUNTY OF SAN DIEGO PRELIMINARY HYDROLOGY STUDY

REDDING MINOR SUBDIVISION TPM 21112

For:

#08-116
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**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

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1.0 INTRODUCTION

The purpose of this report is to calculate the pre-development and post development hydrology conditions for the Redding Minor Subdivision (TPM 21112). This report has been created using the San Diego County Hydrology Manual (June 2003 Edition).

2.0 LOCATION

The project site is located at the end of Puebla Street in Escondido, California. A vicinity map has been included here for reference.



VICINITY MAP
N.T.S.

T.B. PAGE 1150
GRID: D-1

3.0 METHODOLOGY

This report has calculated the 100-Year Design Storm Event discharge rates based on the San Diego County Hydrology Manual (June 2003 Edition) rational methodology found in Section 3. In addition, this manual will be referred to as the 'Standards' throughout this report. Excerpts from the standards have been included in Attachment 1: Standards Excerpts for reference. The hydrology calculations will be divided into two sections: existing conditions and proposed conditions. The existing conditions calculations are provided in Attachment 2: Existing Conditions Calculations. The proposed calculations are provided for reference in Attachment 3: Proposed Conditions. In addition, hydrology maps have been created for the project site and are included in Attachment 4: Hydrology Study Maps. The hydrology calculations have been performed by using CIVILCADD/CIVILDESIGN Engineering Software, © 1991-2006 version 7.7.

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4.0 EXISTING CONDITIONS CALCULATIONS

The existing conditions have been evaluated using the Rational Method from the 2003 San Diego County Hydrology Manual. Certain tables and figures from the Standards are referenced in this report. The referenced items have been included in Attachment 1: Standards Excerpts. The project site has been divided into two distinct drainage sub-basins. The existing conditions calculations are located in Attachment 2 for reference. The Existing Conditions Exhibit is included in Attachment 4 for reference. A summary of the existing conditions is as follows:

EXISTING CONFLUENCE POINT A SUMMARY	
DATA	100-YEAR DESIGN STORM EVENT
INTENSITY (IN/HR)	4.500
TOTAL DISCHARGE (CFS)	153.30
TIME OF CONCENTRATION (MIN)	13.56
AREA (ACRES)	98.96

5.0 PROPOSED CONDITIONS CALCULATIONS

The proposed conditions have been evaluated using the Rational Method from the 2003 San Diego County Hydrology Manual. Certain tables and figures from the Standards are referenced in this report. The referenced items have been included in Attachment 1: Standards Excerpts. The project site has been divided into two distinct drainage sub-basins. The proposed conditions calculations are located in Attachment 3 for reference. The Proposed Conditions Exhibit is included in Attachment 4 for reference. A summary of the proposed conditions is as follows:

PROPOSED CONFLUENCE POINT A SUMMARY	
DATA	100-YEAR DESIGN STORM EVENT
INTENSITY (IN/HR)	4.509
TOTAL DISCHARGE (CFS)	153.66
TIME OF CONCENTRATION (MIN)	13.51
AREA (ACRES)	98.96

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6.0 COMPARISON

During the 100-Year Design Storm Event the existing conditions have a discharge rate of 153.30 cfs. During the 100-Year Design Storm Event the proposed conditions has a discharge rate of 153.66 cfs. The study area does not change from the existing to the proposed conditions. The increase of 0.36 cfs in a 100-Year Design Storm Event is not considered significant in this overall drainage basin because it is an increase of less than 1% overall.

100-YEAR COMPARISON AT CONFLUENCE POINT A			
DATA	EXISTING	PROPOSED	DIFFERENCE
INTENSITY (IN/HR)	4.500	4.509	N/A
TOTAL DISCHARGE (CFS)	153.30	153.66	+ 0.36
Tc (MIN)	13.56	13.51	N/A
AREA (ACRES)	98.96	98.96	+ 0.0

7.0 CONCLUSION

The overall effect of the Redding Minor Subdivision (TPM 21112) is an increase in the 100-Year Design Strom Event discharge rate of 0.36 cfs.

In addition, the following statements apply to the project site:

Drainage Pattern Alteration Statement: The proposed project does not substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site. This will be accomplished through the utilization of vegetated swales, rock swales, and energy dissipation devices designed per current County of San Diego standards.

Flooding Statement: The proposed project does not substantially alter the existing drainage pattern of the site or area including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site. Please refer to the FEMA Firmette provided in Attachment 1 for reference.

Existing Storm Drain Capacity Statement: Since there are no existing storm drain facilities on or adjacent to the project site, there will not be any effect on any local storm drain facilities.

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Housing in a 100-Year Flood Hazard Statement: None of the proposed dwellings are located within a FEMA outlined flooding zone. Please refer to the FEMA Firmette provided in Attachment 1 for reference. In addition, the 100-Year Inundation Line has been calculated using the values of the proposed conditions calculations provided in Attachment 3. Calculations and an exhibit are provided for reference as Attachment 5.

8.0 100-YEAR INUNDATION AREA CALCULATIONS

At the request of the County of San Diego Attachment 5: 100-Year Inundation Area Calculations have been performed on the data provided in Attachment 3 for the southeasterly property line. The data was obtained using CIVILCADD/CIVILDESIGN Engineering Software, © 1991-2006 version 7.7. The depth in the individual channels has been plotted on the topography for the site (County 200 Scale topography with project specific aerial photogrammetry) to create the approximate area of inundation in the 100-year design storm event. Calculations and an exhibit are provided for reference as Attachment 5.

9.0 WATER QUALITY CALCULATIONS

At the request of the County of San Diego Attachment 6: Water Quality Calculations have been performed to calculate the Q_{WC} for each water quality component segment for the project's proposed treatment control best management practices. The data was performed for the benefit of the project's Stormwater Management Plan – Major. This is a separate document in the same County of San Diego file. Please refer to this document for further information. Water Quality Calculations are provided for reference as Attachment 6.

10.0 REFERENCES

The following references were utilized in the creation of this hydrology report:

Brater & King, *Handbook of Hydraulics*, 6th ed.

San Diego Area Regional Standard Drawings, Standard Drawings for Agencies in the San Diego Region, Maintained and Published by the County of San Diego, Department of Public Works April 2006

San Diego County Hydrology Manual, Prepared for the County of San Diego, Department of Public Works, Flood Control Section June 2003.

San Diego County Drainage Design Manual, Prepared for the County of San Diego, Department of Public Works, Flood Control Section May 2005.

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11.0 DECLARATION OF RESPONSIBLE CHARGE

I hereby declare that I am the engineer of work for this project, that I have exercised responsible charge over the design of the project as defined in Section 6703 of the Business and Professions code, and that the design is consistent with current standards. I understand that the check of project drawings and specifications by the County of San Diego is confined to a review only and does not relieve me, as engineer of work, of my responsibilities for project design.

GARY R. WYNN
REGISTERED CIVIL ENGINEER

DATE



12.0 ATTACHMENTS

The following attachment sections are provided for reference:

12.1 ATTACHMENT 1: STANDARD EXCERPTS

This attachment contains excerpts from the standards used to design this hydrology. The attachments are as follows:

County of San Diego Hydrology Manual (2003)

- Soil Hydrologic Groups Map
- Figure 3-1: Intensity-Duration Design Chart (100-Year)
- Rainfall Isopluvial - 100-Year Rainfall Event – 6 Hour
- Rainfall Isopluvial - 100-Year Rainfall Event – 24 Hour
- Table 3-1: Runoff Coefficients for Urban Areas
- Table 3-2: Max Overland Flow Length and Initial Times
- Figure 3-3: Rational Formula – Overland Time of Flow
- Figure 3-7: Manning's Equation Nomograph

San Diego Regional Standard Drawings (2006)

- D-40: Rip Rap Energy Dissipator

FEMA Project Site FIRMETTE

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12.2 ATTACHMENT 2: EXISTING CONDITIONS CALCULATIONS

This attachment contains the existing conditions calculations. The existing conditions calculations are summarized in Section 4 of the report. Calculations are provided here for reference.

12.3 ATTACHMENT 3: PROPOSED CONDITIONS CALCULATIONS

This attachment contains the proposed conditions calculations. The proposed conditions calculations are summarized in Section 5 of the report. Calculations are provided here for reference.

12.4 ATTACHMENT 4: HYDROLOGY STUDY EXHIBITS

The project's vicinity maps, approximate study boundary, Existing Conditions Exhibit, and Proposed Conditions Exhibit are provided here for reference.

12.5 ATTACHMENT 5: 100-YEAR INUNDATION AREA CALCULATIONS

This attachment contains the 100-Year Inundation calculations. Calculations and an exhibit are provided here for reference.

12.6 ATTACHMENT 6: WATER QUALITY CALCULATIONS

This attachment contains the Water Quality Calculations.

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ATTACHMENT 1: STANDARDS EXCERPTS

Please see the attached excerpts from the Standards.

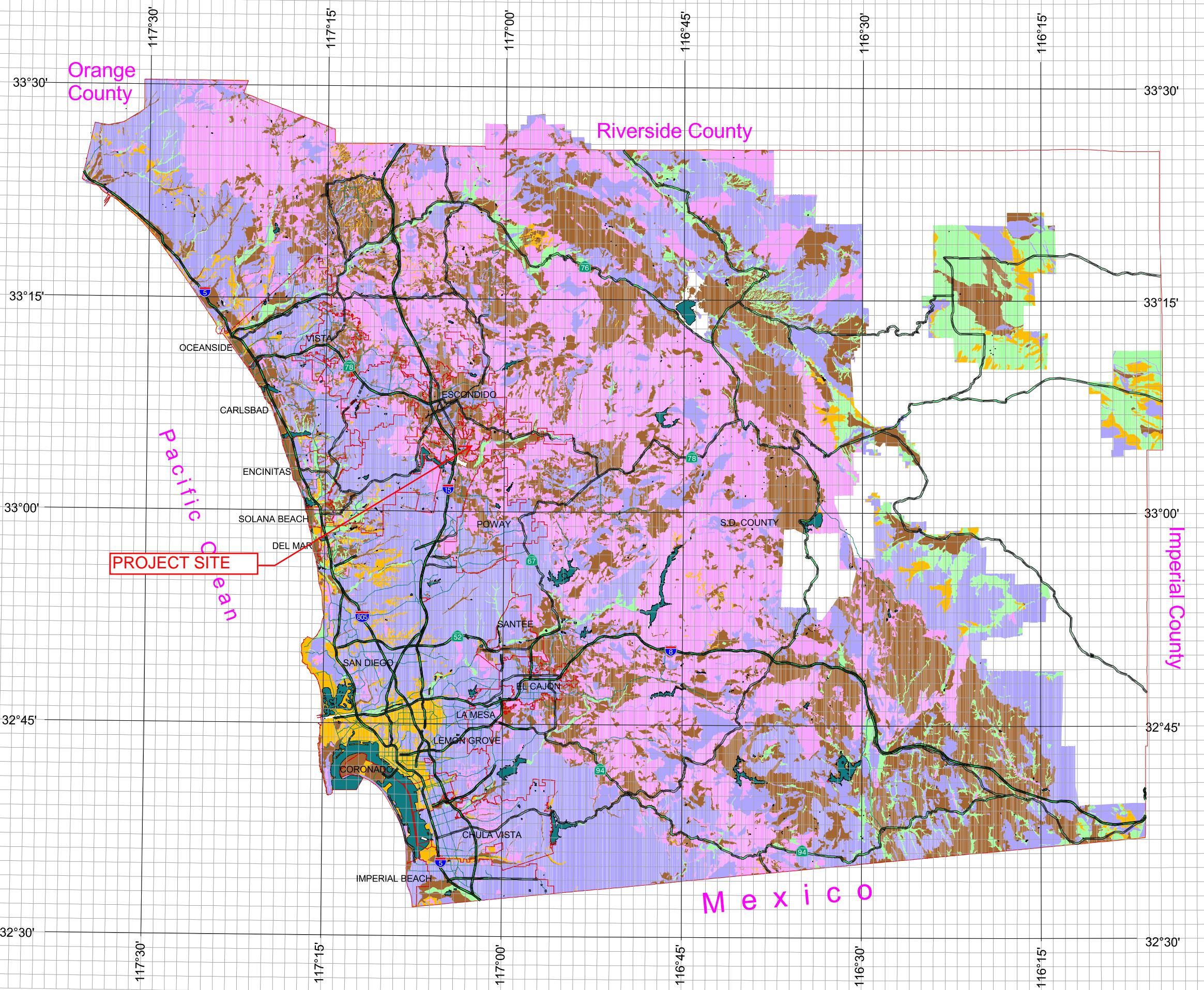
County of San Diego Hydrology Manual



Soil Hydrologic Groups

Legend

Soil Groups	
	Group A
	Group B
	Group C
	Group D
	Undetermined
	Data Unavailable



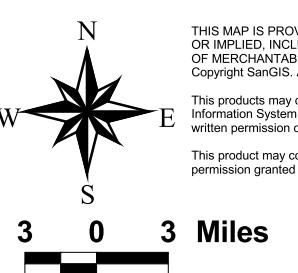
**DPW
GIS**
Department of Public Works
Geographic Information Services

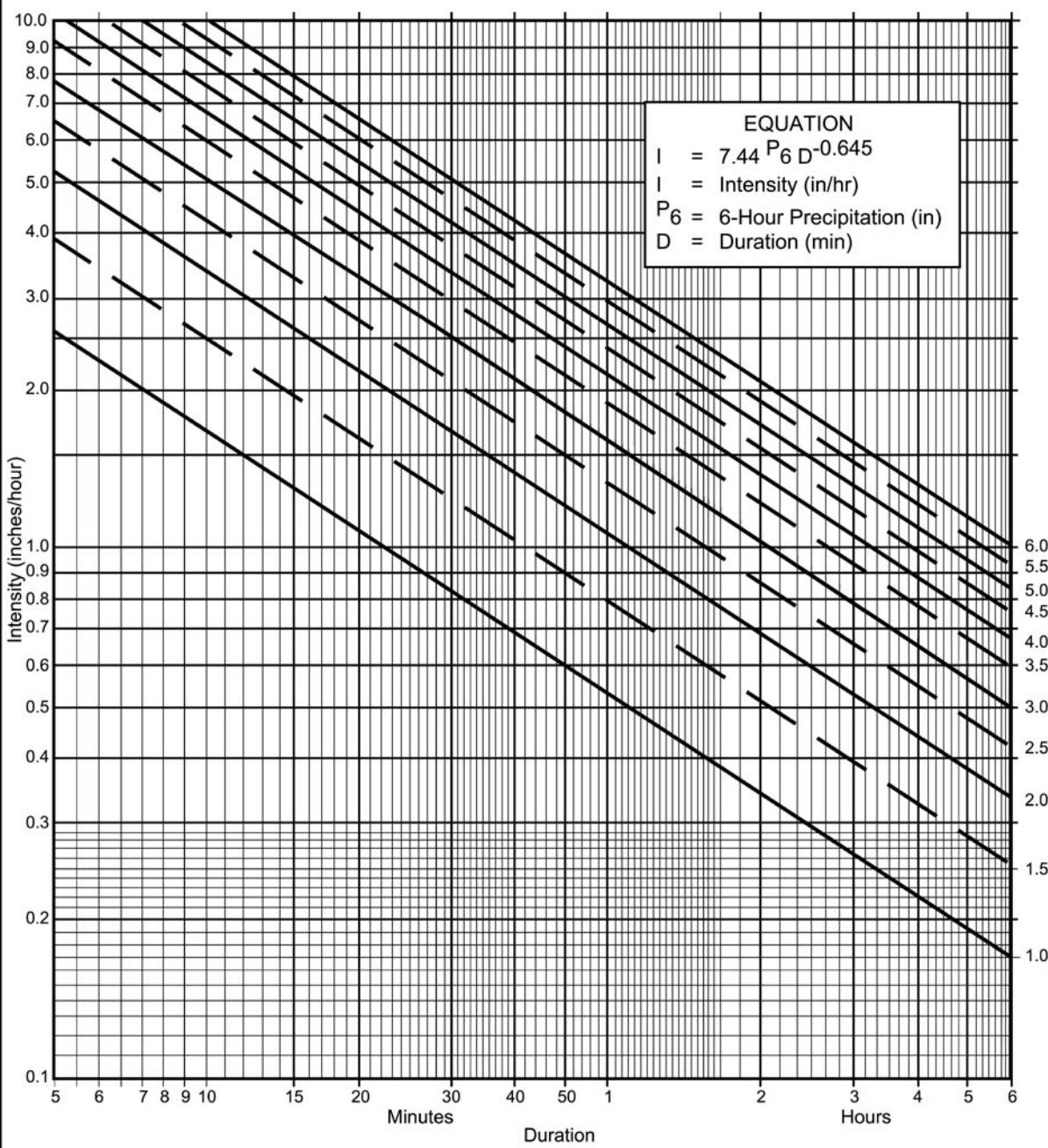
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Directions for Application:

- (1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).
- (2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicable to Desert).
- (3) Plot 6 hr precipitation on the right side of the chart.
- (4) Draw a line through the point parallel to the plotted lines.
- (5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

- (a) Selected frequency 100 year
- (b) $P_6 = \underline{3.25}$ in., $P_{24} = \frac{5.75}{P_6} = \underline{56.5\%}$ ⁽²⁾
- (c) Adjusted $P_6^{(2)} = \underline{3.25}$ in.
- (d) $t_x = \underline{\hspace{2cm}}$ min.
- (e) $I = \underline{\hspace{2cm}}$ in./hr.

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Duration	I	I	I	I	I	I	I	I	I	I	I
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

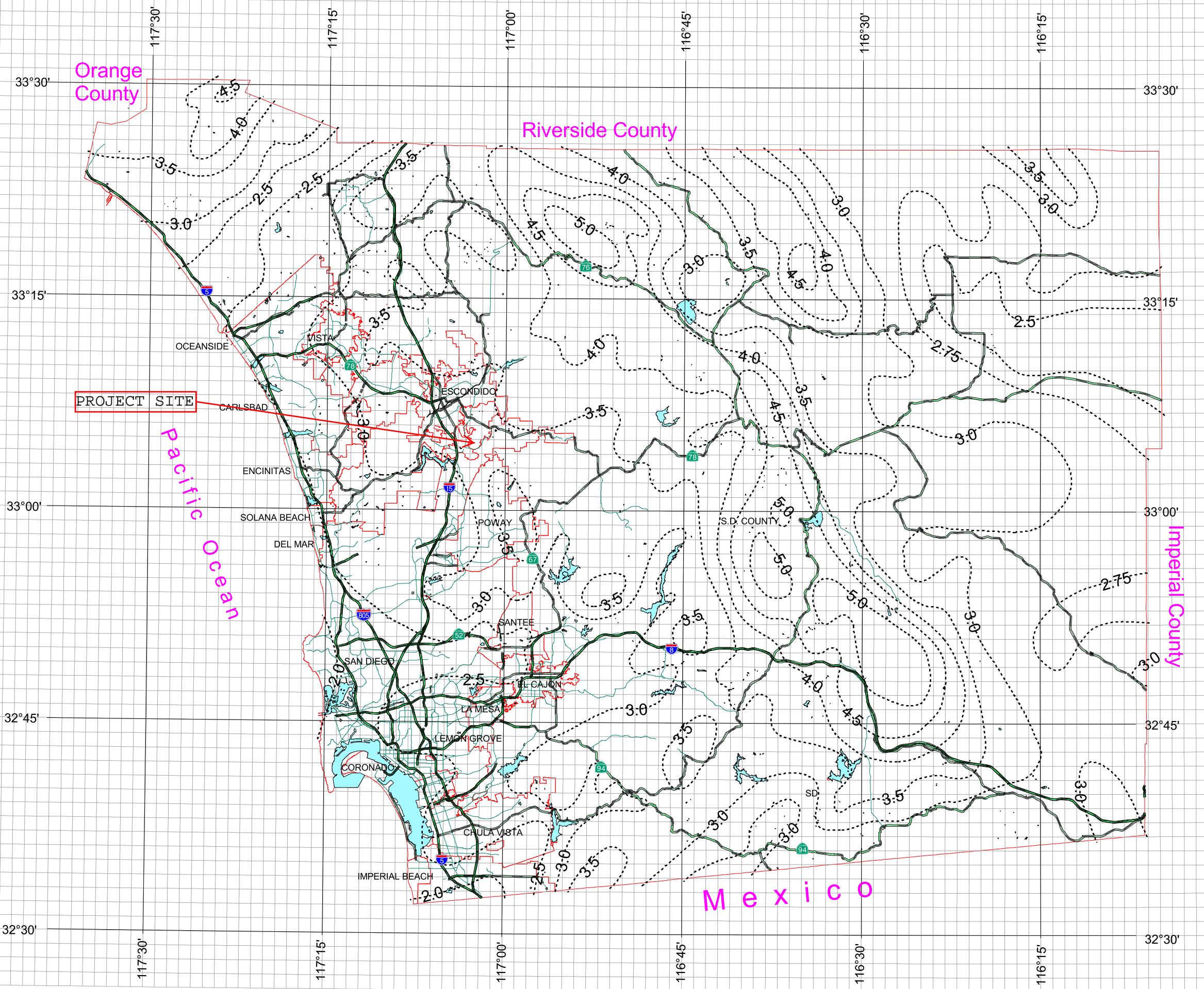
Intensity-Duration Design Chart - Template

FIGURE
3-1

County of San Diego Hydrology Manual



Rainfall Isopluvials



100 Year Rainfall Event - 6 Hours

----- Isopluvial (inches)

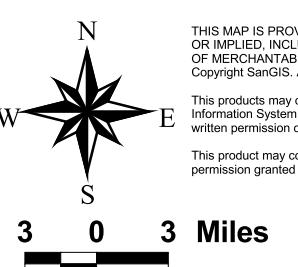
$P_6 = 3.25$



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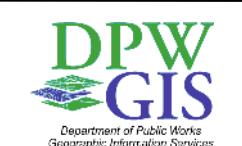
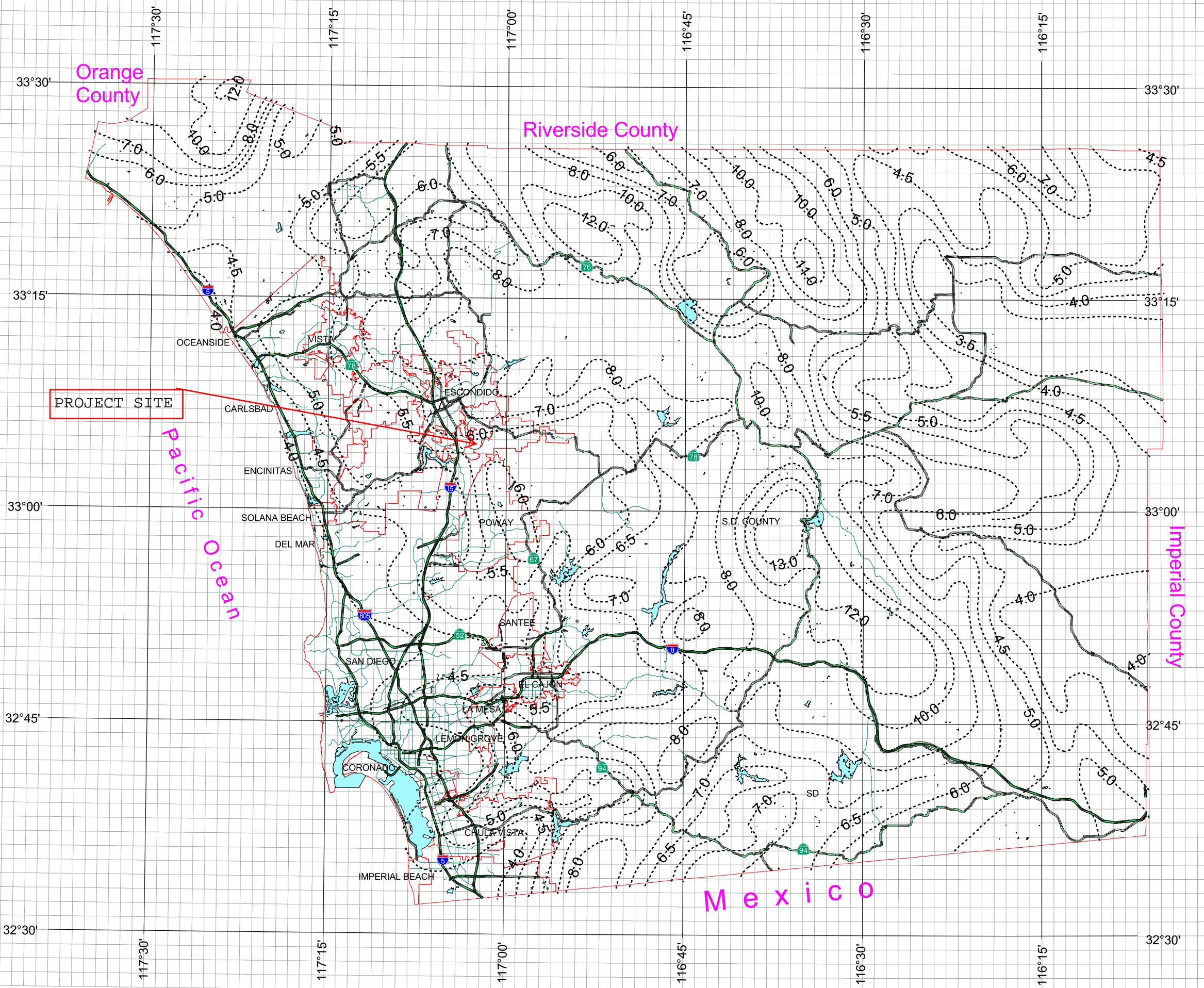
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County of San Diego Hydrology Manual



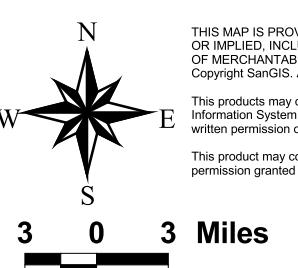
Rainfall Isopluvials

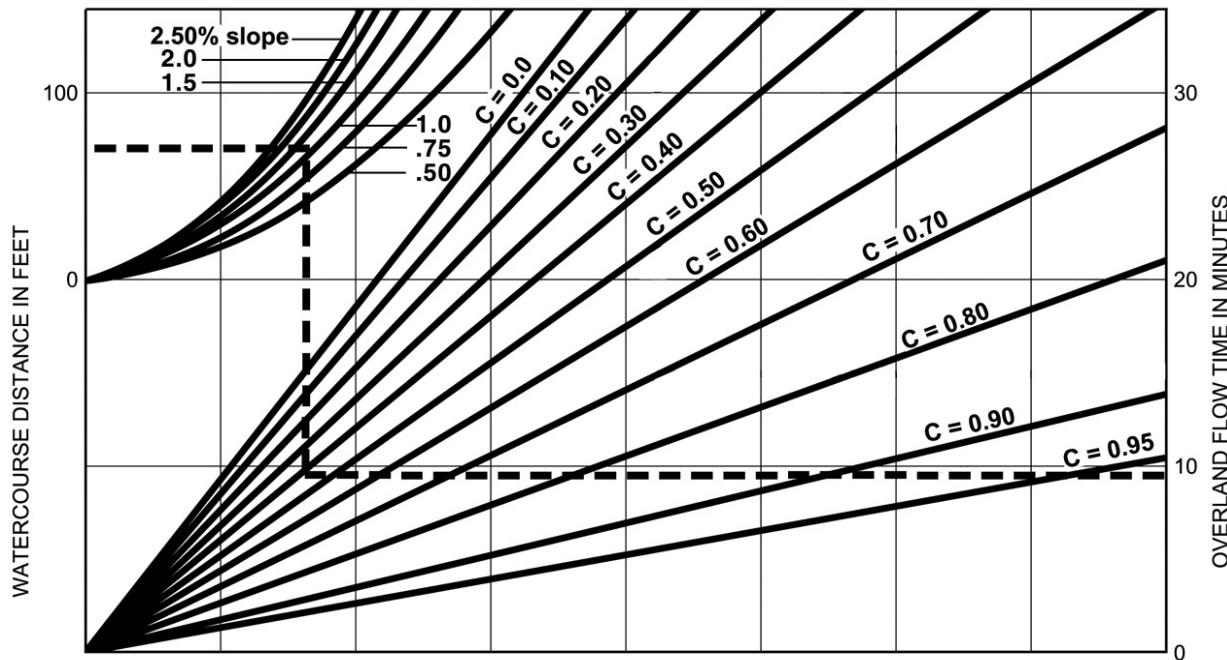


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EXAMPLE:

Given: Watercourse Distance (D) = 70 Feet
 Slope (s) = 1.3%
 Runoff Coefficient (C) = 0.41
 Overland Flow Time (T) = 9.5 Minutes

$$T = \frac{1.8 (1.1-C) \sqrt[3]{D}}{\sqrt[3]{s}}$$

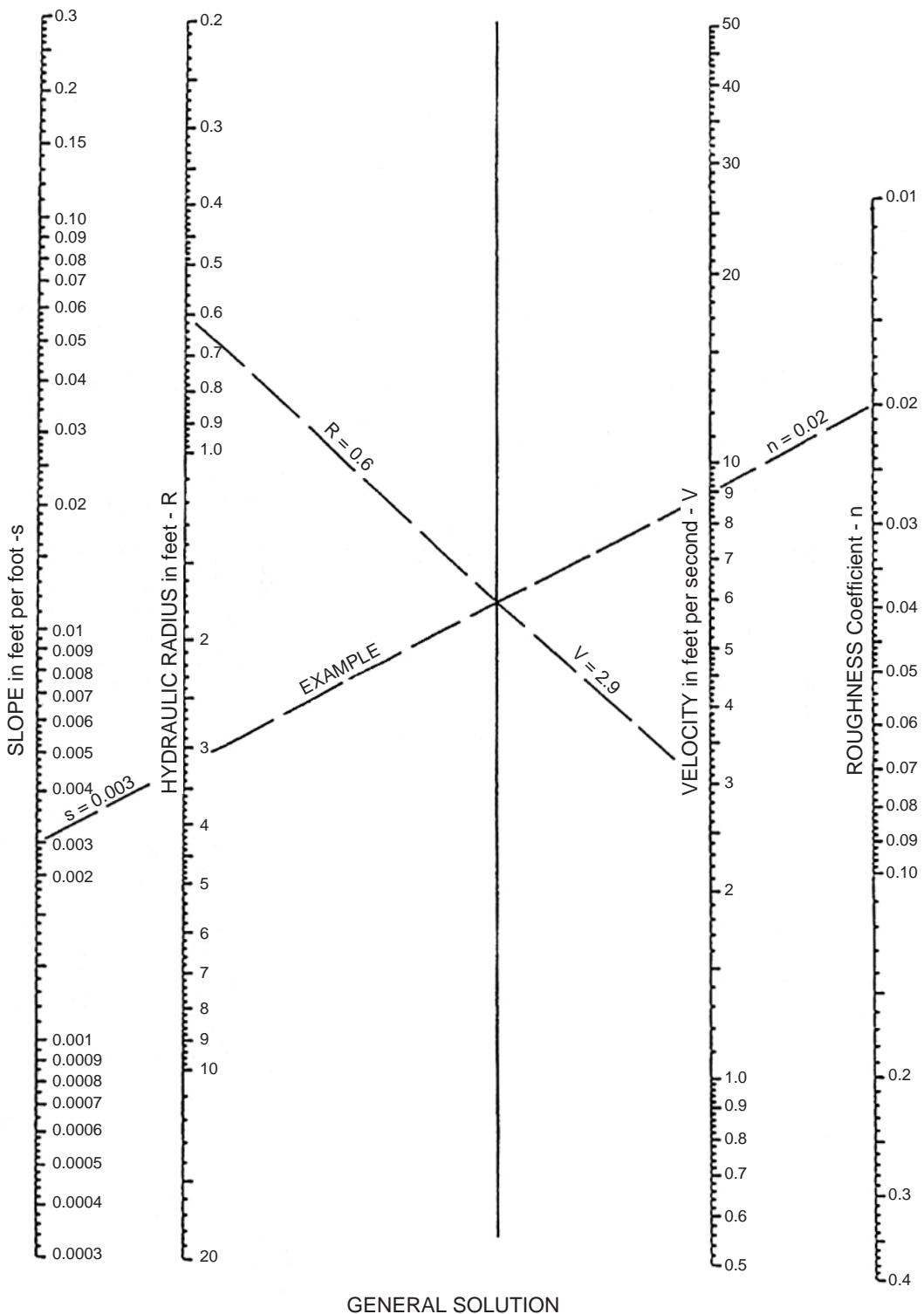
SOURCE: Airport Drainage, Federal Aviation Administration, 1965

FIGURE

Rational Formula - Overland Time of Flow Nomograph

3-3

EQUATION: $V = \frac{1.49}{n} R^{2/3} S^{1/2}$



SOURCE: USDOT, FHWA, HDS-3 (1961)

Manning's Equation Nomograph

3-7

F I G U R E

Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

Land Use		Runoff Coefficient "C"				
NRCS Elements	County Elements	% IMPER.	Soil Type			
			A	B	C	D
Undisturbed Natural Terrain (Natural)	Permanent Open Space	0*	0.20	0.25	0.30	0.35
Low Density Residential (LDR)	Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41
Low Density Residential (LDR)	Residential, 2.0 DU/A or less	20	0.34	0.38	0.42	0.46
Low Density Residential (LDR)	Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49
Medium Density Residential (MDR)	Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52
Medium Density Residential (MDR)	Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	0.57
Medium Density Residential (MDR)	Residential, 10.9 DU/A or less	45	0.52	0.54	0.57	0.60
Medium Density Residential (MDR)	Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63
High Density Residential (HDR)	Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71
High Density Residential (HDR)	Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79
Commercial/Industrial (N. Com)	Neighborhood Commercial	80	0.76	0.77	0.78	0.79
Commercial/Industrial (G. Com)	General Commercial	85	0.80	0.80	0.81	0.82
Commercial/Industrial (O.P. Com)	Office Professional/Commercial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (Limited I.)	Limited Industrial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (General I.)	General Industrial	95	0.87	0.87	0.87	0.87

*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the pervious runoff coefficient, Cp, for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).

DU/A = dwelling units per acre

NRCS = National Resources Conservation Service

Note that the Initial Time of Concentration should be reflective of the general land-use at the upstream end of a drainage basin. A single lot with an area of two or less acres does not have a significant effect where the drainage basin area is 20 to 600 acres.

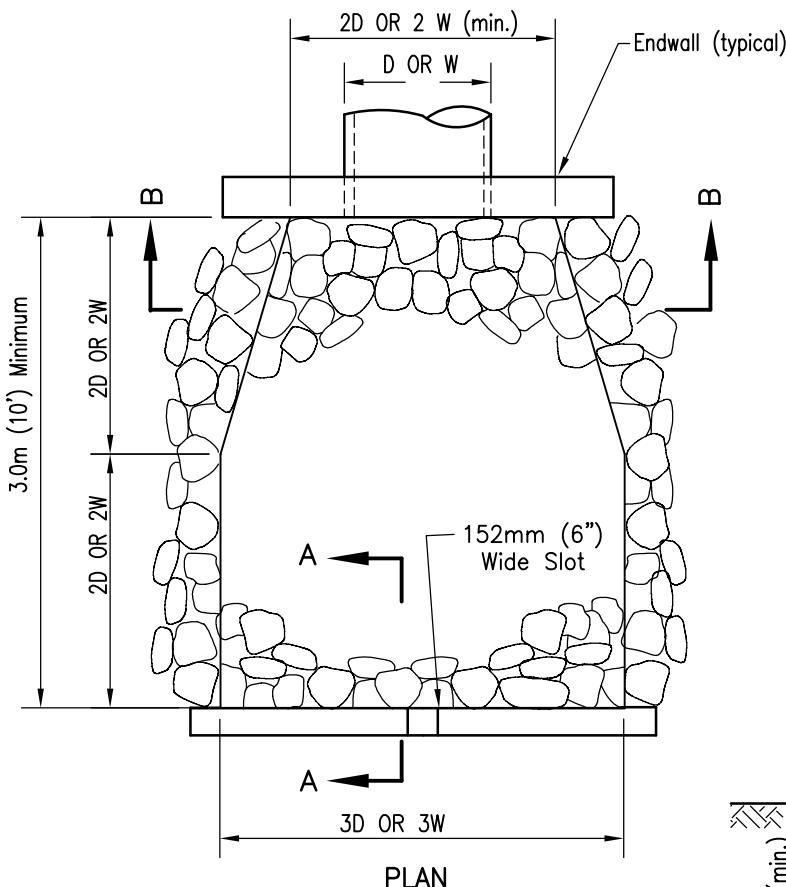
Table 3-2 provides limits of the length (Maximum Length (L_M)) of sheet flow to be used in hydrology studies. Initial T_i values based on average C values for the Land Use Element are also included. These values can be used in planning and design applications as described below. Exceptions may be approved by the “Regulating Agency” when submitted with a detailed study.

Table 3-2

**MAXIMUM OVERLAND FLOW LENGTH (L_M)
& INITIAL TIME OF CONCENTRATION (T_i)**

Element*	DU/ Acre	.5%		1%		2%		3%		5%		10%	
		L_M	T_i										
Natural		50	13.2	70	12.5	85	10.9	100	10.3	100	8.7	100	6.9
LDR	1	50	12.2	70	11.5	85	10.0	100	9.5	100	8.0	100	6.4
LDR	2	50	11.3	70	10.5	85	9.2	100	8.8	100	7.4	100	5.8
LDR	2.9	50	10.7	70	10.0	85	8.8	95	8.1	100	7.0	100	5.6
MDR	4.3	50	10.2	70	9.6	80	8.1	95	7.8	100	6.7	100	5.3
MDR	7.3	50	9.2	65	8.4	80	7.4	95	7.0	100	6.0	100	4.8
MDR	10.9	50	8.7	65	7.9	80	6.9	90	6.4	100	5.7	100	4.5
MDR	14.5	50	8.2	65	7.4	80	6.5	90	6.0	100	5.4	100	4.3
HDR	24	50	6.7	65	6.1	75	5.1	90	4.9	95	4.3	100	3.5
HDR	43	50	5.3	65	4.7	75	4.0	85	3.8	95	3.4	100	2.7
N. Com		50	5.3	60	4.5	75	4.0	85	3.8	95	3.4	100	2.7
G. Com		50	4.7	60	4.1	75	3.6	85	3.4	90	2.9	100	2.4
O.P./Com		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
Limited I.		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
General I.		50	3.7	60	3.2	70	2.7	80	2.6	90	2.3	100	1.9

*See Table 3-1 for more detailed description

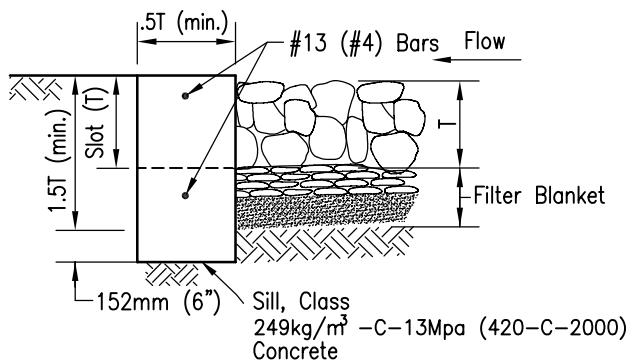


Design Velocity m/sec (ft/sec)*	Rock Classification	T (min)
1.8-3 (6-10)	No. 2 Backing	320mm (1.1ft)
3-3.7 (10-12)	220 kg (1/4 ton)	823mm (2.7ft)
3.7-4.3 (12-14)	450 kg (1/2 ton)	1.1m (3.5ft)
4.3-4.9 (14-16)	900 kg (1 ton)	1.3m (4.4ft)
4.9-5.5 (16-18)	1.8 tonne (2 ton)	1.6m (5.4ft)

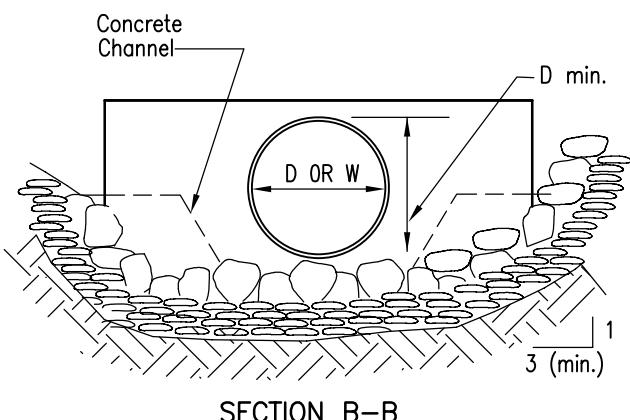
*over 5.5 mps (18 fps) requires special design

D = Pipe Diameter

W = Bottom Width of Channel



SECTION A-A



SECTION B-B

NOTES

- Plans shall specify:
 - Rock Class and thickness (T).
 - Filter material, number of layers and thickness.
- Rip rap shall be either quarry stone or broken concrete (if shown on the plans.) Cobbles are not acceptable.
- Rip rap shall be placed over filter blanket which may be either granular material or filter fabric (woven filter slit film fabric shall not be used).
- See Regional Supplement Amendments for selection of filter blanket.
- Rip rap energy dissipators shall be designated as either Type 1 or Type 2. Type 1 shall be with concrete sill; Type 2 shall be without sill.

Revision	By	Approved	Date
ORIGINAL		Kercheval	12/75
Add Metric	T. Stanton	03/03	
Add Rip Rap Table	S. Brady	04/06	

SAN DIEGO REGIONAL STANDARD DRAWING

RIP RAP ENERGY DISSIPATOR

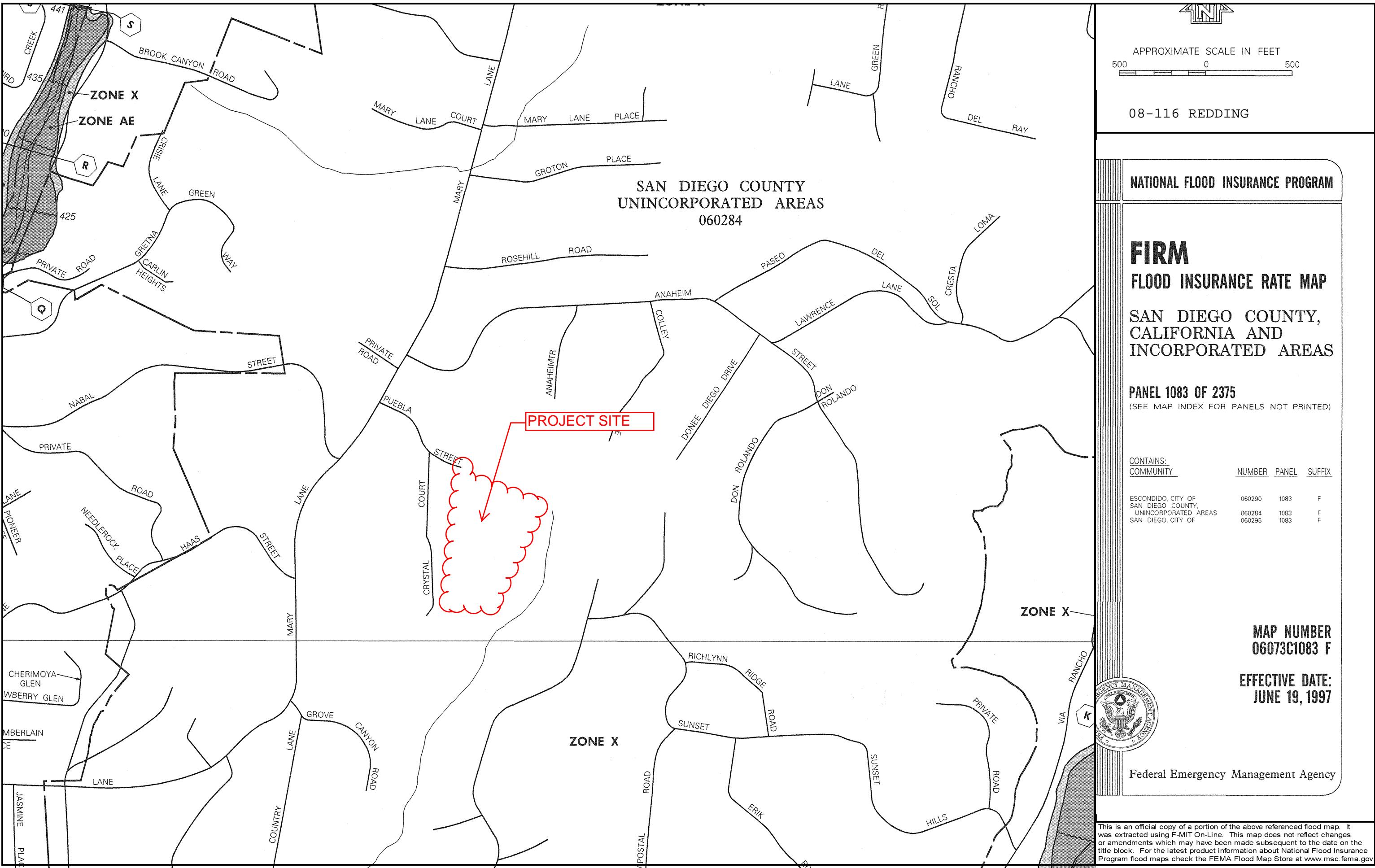
RECOMMENDED BY THE SAN DIEGO REGIONAL STANDARDS COMMITTEE

04/27/2006

Chairperson R.C.E. 19246 Date

DRAWING
NUMBER

D-40



**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

ATTACHMENT 2: EXISTING CONDITIONS CALCULATIONS

100-YEAR DESIGN STORM EVENT

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software, (c)1991-2006 Version 7.7

Rational method hydrology program based on
San Diego County Flood Control Division 2003 hydrology manual
Rational Hydrology Study Date: 03/03/09

REDDING MINOR SUBDIVISION
TPM 21112
PRELIMINARY HYDROLOGY STUDY 100-YEAR DESIGN STORM EVENT
WEI 08-116, RJR, 3-3-09

***** Hydrology Study Control Information *****

Program License Serial Number 6170

Rational hydrology study storm event year is 100.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour, precipitation(inches) = 3.250
24 hour precipitation(inches) = 5.750
P6/P24 = 56.5%
San Diego hydrology manual 'C' values used

+++++
Process from Point/Station 1.011 to Point/Station 1.021
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL]
(1.0 DU/A or Less)
Impervious value, Ai = 0.100
Sub-Area C Value = 0.360
Initial subarea total flow distance = 100.000(Ft.)
Highest elevation = 760.000(Ft.)
Lowest elevation = 753.000(Ft.)
Elevation difference = 7.000(Ft.) Slope = 7.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 7.00 %, in a development type of
1.0 DU/A or Less

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
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In Accordance With Figure 3-3
Initial Area Time of Concentration = 6.96 minutes
 $TC = [1.8 * (1.1 - C) * \text{distance(Ft.)}^{0.5}] / (\% \text{ slope}^{(1/3)})$
 $TC = [1.8 * (1.1 - 0.360) * (100.000^{0.5})] / (7.000^{(1/3)}) = 6.96$
Rainfall intensity (I) = 6.916(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.360
Subarea runoff = 0.772(CFS)
Total initial stream area = 0.310(Ac.)

+++++
Process from Point/Station 1.021 to Point/Station 1.042
***** IRREGULAR CHANNEL FLOW TRAVEL TIME *****

Estimated mean flow rate at midpoint of channel = 9.559(CFS)
Depth of flow = 0.453(Ft.), Average velocity = 9.184(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :
Point number 'X' coordinate 'Y' coordinate
1 0.00 5.00
2 18.20 0.00
3 50.80 5.00
Manning's 'N' friction factor = 0.020

Sub-Channel flow = 9.559(CFS)
' flow top width = 4.599(Ft.)
' velocity= 9.184(Ft/s)
' area = 1.041(Sq.Ft)
' Froude number = 3.402

Upstream point elevation = 753.000(Ft.)
Downstream point elevation = 617.500(Ft.)
Flow length = 1190.000(Ft.)
Travel time = 2.16 min.
Time of concentration = 9.12 min.
Depth of flow = 0.453(Ft.)
Average velocity = 9.184(Ft/s)
Total irregular channel flow = 9.559(CFS)
Irregular channel normal depth above invert elev. = 0.453(Ft.)
Average velocity of channel(s) = 9.184(Ft/s)
Adding area flow to channel
Rainfall intensity (I) = 5.810(In/Hr) for a 100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL]
(1.0 DU/A or Less)
Impervious value, Ai = 0.100
Sub-Area C Value = 0.360
Rainfall intensity = 5.810(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.360 CA = 3.146
Subarea runoff = 17.509(CFS) for 8.430(Ac.)
Total runoff = 18.281(CFS) Total area = 8.740(Ac.)

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Depth of flow = 0.577(Ft.), Average velocity = 10.800(Ft/s)

+++++
Process from Point/Station 1.011 to Point/Station 1.042
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 8.740(Ac.)
Runoff from this stream = 18.281(CFS)
Time of concentration = 9.12 min.
Rainfall intensity = 5.810(In/Hr)

+++++
Process from Point/Station 1.031 to Point/Station 1.041
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL]
(1.0 DU/A or Less)
Impervious value, Ai = 0.100
Sub-Area C Value = 0.360
Initial subarea total flow distance = 100.000(Ft.)
Highest elevation = 694.000(Ft.)
Lowest elevation = 679.000(Ft.)
Elevation difference = 15.000(Ft.) Slope = 15.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 15.00 %, in a development type of
1.0 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration = 5.40 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5]/(% slope^(1/3))
TC = [1.8*(1.1-0.3600)*(100.000^.5)/(15.000^(1/3))] = 5.40
Rainfall intensity (I) = 8.147(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.360
Subarea runoff = 1.320(CFS)
Total initial stream area = 0.450(Ac.)

+++++
Process from Point/Station 1.041 to Point/Station 1.042
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

Estimated mean flow rate at midpoint of channel = 5.782(CFS)
Depth of flow = 0.288(Ft.), Average velocity = 7.563(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :
Point number 'X' coordinate 'Y' coordinate
1 0.00 2.50
2 21.70 0.00

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

3	46.00	2.50	
Manning's 'N' friction factor =	0.020		
<hr/>			
Sub-Channel flow =	5.782(CFS)		
'	flow top width =	5.304(Ft.)	
'	velocity=	7.563(Ft/s)	
'	area =	0.764(Sq.Ft)	
'	Froude number =	3.511	
Upstream point elevation =	679.000(Ft.)		
Downstream point elevation =	617.500(Ft.)		
Flow length =	445.000(Ft.)		
Travel time =	0.98 min.		
Time of concentration =	6.38 min.		
Depth of flow =	0.288(Ft.)		
Average velocity =	7.563(Ft/s)		
Total irregular channel flow =	5.782(CFS)		
Irregular channel normal depth above invert elev. =	0.288(Ft.)		
Average velocity of channel(s) =	7.563(Ft/s)		
Adding area flow to channel			
Rainfall intensity (I) =	7.316(In/Hr) for a 100.0 year storm		
Decimal fraction soil group A =	0.000		
Decimal fraction soil group B =	0.000		
Decimal fraction soil group C =	1.000		
Decimal fraction soil group D =	0.000		
[LOW DENSITY RESIDENTIAL]		
(1.0 DU/A or Less)			
Impervious value, Ai =	0.100		
Sub-Area C Value =	0.360		
Rainfall intensity =	7.316(In/Hr) for a 100.0 year storm		
Effective runoff coefficient used for total area			
(Q=KCIA) is C = 0.360 CA =	1.390		
Subarea runoff =	8.847(CFS) for 3.410(Ac.)		
Total runoff =	10.166(CFS)	Total area =	3.860(Ac.)
Depth of flow =	0.356(Ft.),	Average velocity =	8.709(Ft/s)

+++++
Process from Point/Station 1.031 to Point/Station 1.042
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
 Stream flow area = 3.860(Ac.)
 Runoff from this stream = 10.166(CFS)
 Time of concentration = 6.38 min.
 Rainfall intensity = 7.316(In/Hr)
 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	18.281	9.12	5.810
2	10.166	6.38	7.316
Qmax(1) =		1.000 * 1.000 * 18.281) +	

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
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0.794 * 1.000 * 10.166) + = 26.354
Qmax(2) =
1.000 * 0.700 * 18.281) +
1.000 * 1.000 * 10.166) + = 22.954

Total of 2 streams to confluence:

Flow rates before confluence point:

18.281 10.166

Maximum flow rates at confluence using above data:

26.354 22.954

Area of streams before confluence:

8.740 3.860

Results of confluence:

Total flow rate = 26.354(CFS)

Time of concentration = 9.123 min.

Effective stream area after confluence = 12.600(Ac.)

+++++
Process from Point/Station 1.042 to Point/Station 1.072
***** IRREGULAR CHANNEL FLOW TRAVEL TIME *****

Estimated mean flow rate at midpoint of channel = 27.367(CFS)

Depth of flow = 0.677(Ft.), Average velocity = 13.046(Ft/s)

***** Irregular Channel Data *****

Information entered for subchannel number 1 :

Point number	'X' coordinate	'Y' coordinate
1	0.00	5.00
2	18.60	0.00
3	45.80	5.00

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 27.367(CFS)
' ' flow top width = 6.199(Ft.)
' ' velocity= 13.046(Ft/s)
' ' area = 2.098(Sq.Ft)
' ' Froude number = 3.952

Upstream point elevation = 617.500(Ft.)

Downstream point elevation = 604.000(Ft.)

Flow length = 100.000(Ft.)

Travel time = 0.13 min.

Time of concentration = 9.25 min.

Depth of flow = 0.677(Ft.)

Average velocity = 13.046(Ft/s)

Total irregular channel flow = 27.367(CFS)

Irregular channel normal depth above invert elev. = 0.677(Ft.)

Average velocity of channel(s) = 13.046(Ft/s)

Adding area flow to channel

Rainfall intensity (I) = 5.758(In/Hr) for a 100.0 year storm

Decimal fraction soil group A = 0.000

Decimal fraction soil group B = 0.000

Decimal fraction soil group C = 1.000

Decimal fraction soil group D = 0.000

[LOW DENSITY RESIDENTIAL

]

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

(1.0 DU/A or Less)
Impervious value, $A_i = 0.100$
Sub-Area C Value = 0.360
Rainfall intensity = 5.758(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for total area
($Q=KCIA$) is $C = 0.360$ $CA = 4.918$
Subarea runoff = 1.962(CFS) for 1.060(Ac.)
Total runoff = 28.316(CFS) Total area = 13.660(Ac.)
Depth of flow = 0.685(Ft.), Average velocity = 13.157(Ft/s)

+++++
Process from Point/Station 1.011 to Point/Station 1.072
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 13.660(Ac.)
Runoff from this stream = 28.316(CFS)
Time of concentration = 9.25 min.
Rainfall intensity = 5.758(In/Hr)

+++++
Process from Point/Station 1.061 to Point/Station 1.071
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL]
(1.0 DU/A or Less)
Impervious value, $A_i = 0.100$
Sub-Area C Value = 0.360
Initial subarea total flow distance = 100.000(Ft.)
Highest elevation = 686.000(Ft.)
Lowest elevation = 679.000(Ft.)
Elevation difference = 7.000(Ft.) Slope = 7.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 7.00 %, in a development type of
1.0 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration = 6.96 minutes
 $TC = [1.8 * (1.1 - C) * distance(Ft.)^{.5}] / (% slope^{(1/3)})$
 $TC = [1.8 * (1.1 - 0.360) * (100.000^{.5}) / (7.000^{(1/3)})] = 6.96$
Rainfall intensity (I) = 6.916(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area ($Q=KCIA$) is $C = 0.360$
Subarea runoff = 0.548(CFS)
Total initial stream area = 0.220(Ac.)

+++++
Process from Point/Station 1.071 to Point/Station 1.072
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Estimated mean flow rate at midpoint of channel = 3.378(CFS)
Depth of flow = 0.297(Ft.), Average velocity = 8.041(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :

Point number	'X' coordinate	'Y' coordinate
1	0.00	5.00
2	22.20	0.00
3	47.50	5.00

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 3.378(CFS)
' ' flow top width = 2.825(Ft.)
' ' velocity= 8.041(Ft/s)
' ' area = 0.420(Sq.Ft)
' ' Froude number = 3.675

Upstream point elevation = 679.000(Ft.)

Downstream point elevation = 604.000(Ft.)

Flow length = 490.000(Ft.)

Travel time = 1.02 min.

Time of concentration = 7.98 min.

Depth of flow = 0.297(Ft.)

Average velocity = 8.041(Ft/s)

Total irregular channel flow = 3.378(CFS)

Irregular channel normal depth above invert elev. = 0.297(Ft.)

Average velocity of channel(s) = 8.041(Ft/s)

Adding area flow to channel

Rainfall intensity (I) = 6.334(In/Hr) for a 100.0 year storm

Decimal fraction soil group A = 0.000

Decimal fraction soil group B = 0.000

Decimal fraction soil group C = 1.000

Decimal fraction soil group D = 0.000

[LOW DENSITY RESIDENTIAL]

(1.0 DU/A or Less)

Impervious value, Ai = 0.100

Sub-Area C Value = 0.360

Rainfall intensity = 6.334(In/Hr) for a 100.0 year storm

Effective runoff coefficient used for total area

(Q=KCIA) is C = 0.360 CA = 0.968

Subarea runoff = 5.587(CFS) for 2.470(Ac.)

Total runoff = 6.134(CFS) Total area = 2.690(Ac.)

Depth of flow = 0.372(Ft.), Average velocity = 9.334(Ft/s)

+++++
Process from Point/Station 1.061 to Point/Station 1.072

**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2

Stream flow area = 2.690(Ac.)

Runoff from this stream = 6.134(CFS)

Time of concentration = 7.98 min.

Rainfall intensity = 6.334(In/Hr)

Summary of stream data:

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Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
---------------	--------------------	-------------	-------------------------------

1	28.316	9.25	5.758
2	6.134	7.98	6.334
Qmax(1) =			
	1.000 *	1.000 *	28.316) +
	0.909 *	1.000 *	6.134) + = 33.892
Qmax(2) =			
	1.000 *	0.863 *	28.316) +
	1.000 *	1.000 *	6.134) + = 30.558

Total of 2 streams to confluence:

Flow rates before confluence point:

28.316 6.134

Maximum flow rates at confluence using above data:

33.892 30.558

Area of streams before confluence:

13.660 2.690

Results of confluence:

Total flow rate = 33.892(CFS)

Time of concentration = 9.250 min.

Effective stream area after confluence = 16.350(Ac.)

+++++
Process from Point/Station 1.072 to Point/Station 1.122
***** IRREGULAR CHANNEL FLOW TRAVEL TIME *****

Estimated mean flow rate at midpoint of channel = 33.974(CFS)
Depth of flow = 0.990(Ft.), Average velocity = 9.770(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :

Point number	'X' coordinate	'Y' coordinate
1	0.00	5.00
2	16.70	0.00
3	35.50	5.00

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 33.974(CFS)
' flow top width = 7.027(Ft.)
' velocity= 9.770(Ft/s)
' area = 3.477(Sq.Ft)
' Froude number = 2.448

Upstream point elevation = 604.000(Ft.)

Downstream point elevation = 551.000(Ft.)

Flow length = 1140.000(Ft.)

Travel time = 1.94 min.

Time of concentration = 11.20 min.

Depth of flow = 0.990(Ft.)

Average velocity = 9.770(Ft/s)

Total irregular channel flow = 33.974(CFS)

Irregular channel normal depth above invert elev. = 0.990(Ft.)

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Average velocity of channel(s) = 9.770(Ft/s)
Adding area flow to channel
Rainfall intensity (I) = 5.091(In/Hr) for a 100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL]
(1.0 DU/A or Less)
Impervious value, Ai = 0.100
Sub-Area C Value = 0.360
Rainfall intensity = 5.091(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.360 CA = 6.674
Subarea runoff = 0.089(CFS) for 2.190(Ac.)
Total runoff = 33.982(CFS) Total area = 18.540(Ac.)
Depth of flow = 0.990(Ft.), Average velocity = 9.771(Ft/s)

+++++
Process from Point/Station 1.011 to Point/Station 1.122
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 18.540(Ac.)
Runoff from this stream = 33.982(CFS)
Time of concentration = 11.20 min.
Rainfall intensity = 5.091(In/Hr)

+++++
Process from Point/Station 1.091 to Point/Station 1.101
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL]
(1.0 DU/A or Less)
Impervious value, Ai = 0.100
Sub-Area C Value = 0.360
Initial subarea total flow distance = 100.000(Ft.)
Highest elevation = 676.000(Ft.)
Lowest elevation = 674.000(Ft.)
Elevation difference = 2.000(Ft.) Slope = 2.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 85.00 (Ft)
for the top area slope value of 2.00 %, in a development type of
1.0 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration = 9.75 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5]/(% slope^(1/3))
TC = [1.8*(1.1-0.3600)*(85.000^.5)/(2.000^(1/3))] = 9.75
The initial area total distance of 100.00 (Ft.) entered leaves a
remaining distance of 15.00 (Ft.)

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Using Figure 3-4, the travel time for this distance is 0.28 minutes for a distance of 15.00 (Ft.) and a slope of 2.00 % with an elevation difference of 0.30(Ft.) from the end of the top area
 $T_t = [11.9 * \text{length(Mi)}^3] / (\text{elevation change(Ft.)})^{.385} * 60(\text{min/hr})$
= 0.283 Minutes
 $T_t = [(11.9 * 0.0028^3) / (0.30)]^{.385} = 0.28$
Total initial area $T_i = 9.75$ minutes from Figure 3-3 formula plus 0.28 minutes from the Figure 3-4 formula = 10.03 minutes
Rainfall intensity (I) = 5.465(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area ($Q=KCIA$) is $C = 0.360$
Subarea runoff = 0.689(CFS)
Total initial stream area = 0.350(Ac.)

+
Process from Point/Station 1.101 to Point/Station 1.122
***** IRREGULAR CHANNEL FLOW TRAVEL TIME *****

Estimated mean flow rate at midpoint of channel = 6.447(CFS)
Depth of flow = 0.510(Ft.), Average velocity = 10.674(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :
Point number 'X' coordinate 'Y' coordinate
1 0.00 5.00
2 12.70 0.00
3 23.20 5.00

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 6.447(CFS)
' ' flow top width = 2.367(Ft.)
' ' velocity= 10.674(Ft/s)
' ' area = 0.604(Sq.Ft)
' ' Froude number = 3.724

Upstream point elevation = 674.000(Ft.)
Downstream point elevation = 551.000(Ft.)

Flow length = 860.000(Ft.)

Travel time = 1.34 min.

Time of concentration = 11.37 min.

Depth of flow = 0.510(Ft.)

Average velocity = 10.674(Ft/s)

Total irregular channel flow = 6.447(CFS)

Irregular channel normal depth above invert elev. = 0.510(Ft.)

Average velocity of channel(s) = 10.674(Ft/s)

Adding area flow to channel

Rainfall intensity (I) = 5.040(In/Hr) for a 100.0 year storm

Decimal fraction soil group A = 0.000

Decimal fraction soil group B = 0.000

Decimal fraction soil group C = 1.000

Decimal fraction soil group D = 0.000

[LOW DENSITY RESIDENTIAL]

(1.0 DU/A or Less)

Impervious value, $A_i = 0.100$

Sub-Area C Value = 0.360

Rainfall intensity = 5.040(In/Hr) for a 100.0 year storm

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.360 CA = 2.408
Subarea runoff = 11.449(CFS) for 6.340(Ac.)
Total runoff = 12.138(CFS) Total area = 6.690(Ac.)
Depth of flow = 0.647(Ft.), Average velocity = 12.504(Ft/s)

+++++
Process from Point/Station 1.091 to Point/Station 1.122
***** CONFLUENCE OF MINOR STREAMS *****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 6.690(Ac.)
Runoff from this stream = 12.138(CFS)
Time of concentration = 11.37 min.
Rainfall intensity = 5.040(In/Hr)

+++++
Process from Point/Station 1.111 to Point/Station 1.121
***** INITIAL AREA EVALUATION *****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL]
(1.0 DU/A or Less)
Impervious value, Ai = 0.100
Sub-Area C Value = 0.360
Initial subarea total flow distance = 100.000(Ft.)
Highest elevation = 7667.000(Ft.)
Lowest elevation = 757.000(Ft.)
Elevation difference = 6910.000(Ft.) Slope = 6910.000 %
Top of Initial Area Slope adjusted by User to 10.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 10.00 %, in a development type of
1.0 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration = 6.18 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5]/(% slope^(1/3))
TC = [1.8*(1.1-0.360)*(100.000^.5)/(10.000^(1/3))] = 6.18
Rainfall intensity (I) = 7.467(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.360
Subarea runoff = 0.565(CFS)
Total initial stream area = 0.210(Ac.)

+++++
Process from Point/Station 1.121 to Point/Station 1.122
***** IRREGULAR CHANNEL FLOW TRAVEL TIME *****

Estimated mean flow rate at midpoint of channel = 13.847(CFS)
Depth of flow = 0.502(Ft.), Average velocity = 9.985(Ft/s)
***** Irregular Channel Data *****

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
| 1 | 0.00 | 5.00 |
| 2 | 17.10 | 0.00 |
| 3 | 55.10 | 5.00 |

Manning's 'N' friction factor = 0.020

| Sub-Channel flow | = 13.847(CFS) |
|------------------|-----------------------------|
| ' | flow top width = 5.529(Ft.) |
| ' | velocity= 9.985(Ft/s) |
| ' | area = 1.387(Sq.Ft) |
| ' | Froude number = 3.513 |

Upstream point elevation = 757.000(Ft.)

Downstream point elevation = 551.000(Ft.)

Flow length = 1760.000(Ft.)

Travel time = 2.94 min.

Time of concentration = 9.12 min.

Depth of flow = 0.502(Ft.)

Average velocity = 9.985(Ft/s)

Total irregular channel flow = 13.847(CFS)

Irregular channel normal depth above invert elev. = 0.502(Ft.)

Average velocity of channel(s) = 9.985(Ft/s)

Adding area flow to channel

Rainfall intensity (I) = 5.811(In/Hr) for a 100.0 year storm

Decimal fraction soil group A = 0.000

Decimal fraction soil group B = 0.000

Decimal fraction soil group C = 1.000

Decimal fraction soil group D = 0.000

[LOW DENSITY RESIDENTIAL]

(1.0 DU/A or Less)

Impervious value, Ai = 0.100

Sub-Area C Value = 0.360

Rainfall intensity = 5.811(In/Hr) for a 100.0 year storm

Effective runoff coefficient used for total area

(Q=KCIA) is C = 0.360 CA = 4.655

Subarea runoff = 26.484(CFS) for 12.720(Ac.)

Total runoff = 27.049(CFS) Total area = 12.930(Ac.)

Depth of flow = 0.645(Ft.), Average velocity = 11.804(Ft/s)

+++++
Process from Point/Station 1.111 to Point/Station 1.122

**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 3

Stream flow area = 12.930(Ac.)

Runoff from this stream = 27.049(CFS)

Time of concentration = 9.12 min.

Rainfall intensity = 5.811(In/Hr)

Summary of stream data:

| Stream No. | Flow rate (CFS) | TC (min) | Rainfall Intensity (In/Hr) |
|------------|-----------------|----------|----------------------------|
|------------|-----------------|----------|----------------------------|

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

| | | | |
|-----------|---------|---------|--------------------|
| 1 | 33.982 | 11.20 | 5.091 |
| 2 | 12.138 | 11.37 | 5.040 |
| 3 | 27.049 | 9.12 | 5.811 |
| Qmax(1) = | | | |
| | 1.000 * | 1.000 * | 33.982) + |
| | 1.000 * | 0.984 * | 12.138) + |
| | 0.876 * | 1.000 * | 27.049) + = 69.629 |
| Qmax(2) = | | | |
| | 0.990 * | 1.000 * | 33.982) + |
| | 1.000 * | 1.000 * | 12.138) + |
| | 0.867 * | 1.000 * | 27.049) + = 69.235 |
| Qmax(3) = | | | |
| | 1.000 * | 0.815 * | 33.982) + |
| | 1.000 * | 0.802 * | 12.138) + |
| | 1.000 * | 1.000 * | 27.049) + = 64.467 |

Total of 3 streams to confluence:

Flow rates before confluence point:

| | | |
|--------|--------|--------|
| 33.982 | 12.138 | 27.049 |
|--------|--------|--------|

Maximum flow rates at confluence using above data:

| | | |
|--------|--------|--------|
| 69.629 | 69.235 | 64.467 |
|--------|--------|--------|

Area of streams before confluence:

| | | |
|--------|-------|--------|
| 18.540 | 6.690 | 12.930 |
|--------|-------|--------|

Results of confluence:

Total flow rate = 69.629(CFS)

Time of concentration = 11.195 min.

Effective stream area after confluence = 38.160(Ac.)

+++++
Process from Point/Station 1.122 to Point/Station 1.162
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

Depth of flow = 1.330(Ft.), Average velocity = 11.155(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
| 1 | 0.00 | 5.00 |
| 2 | 19.10 | 0.00 |
| 3 | 35.30 | 5.00 |

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 69.629(CFS)
' ' flow top width = 9.388(Ft.)
' ' velocity= 11.155(Ft/s)
' ' area = 6.242(Sq.Ft)
' ' Froude number = 2.411

Upstream point elevation = 551.000(Ft.)

Downstream point elevation = 542.000(Ft.)

Flow length = 220.000(Ft.)

Travel time = 0.33 min.

Time of concentration = 11.52 min.

Depth of flow = 1.330(Ft.)

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Average velocity = 11.155(Ft/s)
Total irregular channel flow = 69.629(CFS)
Irregular channel normal depth above invert elev. = 1.330(Ft.)
Average velocity of channel(s) = 11.155(Ft/s)

+++++
Process from Point/Station 1.011 to Point/Station 1.162
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 38.160(Ac.)
Runoff from this stream = 69.629(CFS)
Time of concentration = 11.52 min.
Rainfall intensity = 4.997(In/Hr)

+++++
Process from Point/Station 1.131 to Point/Station 1.141
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[UNDISTURBED NATURAL TERRAIN]
(Permanent Open Space)
Impervious value, Ai = 0.000
Sub-Area C Value = 0.300
Initial subarea total flow distance = 100.000(Ft.)
Highest elevation = 645.000(Ft.)
Lowest elevation = 636.000(Ft.)
Elevation difference = 9.000(Ft.) Slope = 9.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 9.00 %, in a development type of
Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration = 6.92 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.300)*(100.000^.5)/(9.000^(1/3)] = 6.92
Rainfall intensity (I) = 6.942(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.300
Subarea runoff = 0.375(CFS)
Total initial stream area = 0.180(Ac.)

+++++
Process from Point/Station 1.141 to Point/Station 1.162
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

Estimated mean flow rate at midpoint of channel = 1.965(CFS)
Depth of flow = 0.196(Ft.), Average velocity = 7.788(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
| 1 | 0.00 | 5.00 |
| 2 | 39.30 | 0.00 |
| 3 | 65.80 | 5.00 |

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 1.965(CFS)

| | | |
|---|---|-----------------------------|
| ' | ' | flow top width = 2.577(Ft.) |
| ' | ' | velocity= 7.788(Ft/s) |
| ' | ' | area = 0.252(Sq.Ft) |
| ' | ' | Froude number = 4.386 |

Upstream point elevation = 636.000(Ft.)

Downstream point elevation = 542.000(Ft.)

Flow length = 380.000(Ft.)

Travel time = 0.81 min.

Time of concentration = 7.74 min.

Depth of flow = 0.196(Ft.)

Average velocity = 7.788(Ft/s)

Total irregular channel flow = 1.965(CFS)

Irregular channel normal depth above invert elev. = 0.196(Ft.)

Average velocity of channel(s) = 7.788(Ft/s)

Adding area flow to channel

Rainfall intensity (I) = 6.462(In/Hr) for a 100.0 year storm

Decimal fraction soil group A = 0.000

Decimal fraction soil group B = 0.000

Decimal fraction soil group C = 1.000

Decimal fraction soil group D = 0.000

[UNDISTURBED NATURAL TERRAIN]

(Permanent Open Space)

Impervious value, Ai = 0.000

Sub-Area C Value = 0.300

Rainfall intensity = 6.462(In/Hr) for a 100.0 year storm

Effective runoff coefficient used for total area

(Q=KCIA) is C = 0.300 CA = 0.540

Subarea runoff = 3.115(CFS) for 1.620(Ac.)

Total runoff = 3.489(CFS) Total area = 1.800(Ac.)

Depth of flow = 0.243(Ft.), Average velocity = 8.991(Ft/s)

+++++
Process from Point/Station 1.131 to Point/Station 1.162

**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2

Stream flow area = 1.800(Ac.)

Runoff from this stream = 3.489(CFS)

Time of concentration = 7.74 min.

Rainfall intensity = 6.462(In/Hr)

+++++
Process from Point/Station 1.151 to Point/Station 1.161

**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL]
(1.0 DU/A or Less)
Impervious value, Ai = 0.100
Sub-Area C Value = 0.360
Initial subarea total flow distance = 100.000(Ft.)
Highest elevation = 714.000(Ft.)
Lowest elevation = 695.000(Ft.)
Elevation difference = 19.000(Ft.) Slope = 19.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 19.00 %, in a development type of
1.0 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration = 4.99 minutes
TC = $[1.8 * (1.1 - C) * \text{distance}(\text{Ft.})^{0.5}] / (\% \text{slope}^{(1/3)})$
TC = $[1.8 * (1.1 - 0.3600) * (100.000^{0.5}) / (19.000^{(1/3)})] = 4.99$
Calculated TC of 4.992 minutes is less than 5 minutes,
resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) = 8.563(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.360
Subarea runoff = 2.620(CFS)
Total initial stream area = 0.850(Ac.)

+++++
Process from Point/Station 1.161 to Point/Station 1.162
***** IRREGULAR CHANNEL FLOW TRAVEL TIME *****

Estimated mean flow rate at midpoint of channel = 19.992(CFS)
Depth of flow = 0.768(Ft.), Average velocity = 11.739(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :
Point number 'X' coordinate 'Y' coordinate
1 0.00 5.00
2 17.80 0.00
3 28.90 5.00
Manning's 'N' friction factor = 0.020

Sub-Channel flow = 19.992(CFS)
' flow top width = 4.437(Ft.)
' velocity= 11.739(Ft/s)
' area = 1.703(Sq.Ft)
' Froude number = 3.339

Upstream point elevation = 695.000(Ft.)
Downstream point elevation = 542.000(Ft.)
Flow length = 1580.000(Ft.)
Travel time = 2.24 min.
Time of concentration = 7.24 min.
Depth of flow = 0.768(Ft.)
Average velocity = 11.739(Ft/s)
Total irregular channel flow = 19.992(CFS)

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Irregular channel normal depth above invert elev. = 0.768(Ft.)
Average velocity of channel(s) = 11.739(Ft/s)
Adding area flow to channel
Rainfall intensity (I) = 6.747(In/Hr) for a 100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[UNDISTURBED NATURAL TERRAIN]
(Permanent Open Space)
Impervious value, Ai = 0.000
Sub-Area C Value = 0.300
Rainfall intensity = 6.747(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.303 CA = 5.523
Subarea runoff = 34.644(CFS) for 17.390(Ac.)
Total runoff = 37.264(CFS) Total area = 18.240(Ac.)
Depth of flow = 0.970(Ft.), Average velocity = 13.716(Ft/s)

+++++
Process from Point/Station 1.151 to Point/Station 1.162
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 3
Stream flow area = 18.240(Ac.)
Runoff from this stream = 37.264(CFS)
Time of concentration = 7.24 min.
Rainfall intensity = 6.747(In/Hr)
Summary of stream data:

| Stream No. | Flow rate (CFS) | TC (min) | Rainfall Intensity (In/Hr) |
|------------|-----------------|-------------|----------------------------|
| 1 | 69.629 | 11.52 | 4.997 |
| 2 | 3.489 | 7.74 | 6.462 |
| 3 | 37.264 | 7.24 | 6.747 |
| Qmax(1) = | | | |
| | 1.000 * 1.000 * | 69.629) + | |
| | 0.773 * 1.000 * | 3.489) + | |
| | 0.741 * 1.000 * | 37.264) + = | 99.927 |
| Qmax(2) = | | | |
| | 1.000 * 0.671 * | 69.629) + | |
| | 1.000 * 1.000 * | 3.489) + | |
| | 0.958 * 1.000 * | 37.264) + = | 85.921 |
| Qmax(3) = | | | |
| | 1.000 * 0.628 * | 69.629) + | |
| | 1.000 * 0.935 * | 3.489) + | |
| | 1.000 * 1.000 * | 37.264) + = | 84.243 |

Total of 3 streams to confluence:

Flow rates before confluence point:

69.629 3.489 37.264

Maximum flow rates at confluence using above data:

99.927 85.921 84.243

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Area of streams before confluence:
38.160 1.800 18.240

Results of confluence:

Total flow rate = 99.927(CFS)

Time of concentration = 11.524 min.

Effective stream area after confluence = 58.200(Ac.)

+++++
Process from Point/Station 1.162 to Point/Station 1.202
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

Depth of flow = 1.504(Ft.), Average velocity = 12.509(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
| 1 | 0.00 | 5.00 |
| 2 | 19.10 | 0.00 |
| 3 | 35.30 | 5.00 |

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 99.927(CFS)
' flow top width = 10.621(Ft.)
' velocity= 12.509(Ft/s)
' area = 7.989(Sq.Ft)
' Froude number = 2.542

Upstream point elevation = 542.000(Ft.)

Downstream point elevation = 530.000(Ft.)

Flow length = 275.000(Ft.)

Travel time = 0.37 min.

Time of concentration = 11.89 min.

Depth of flow = 1.504(Ft.)

Average velocity = 12.509(Ft/s)

Total irregular channel flow = 99.927(CFS)

Irregular channel normal depth above invert elev. = 1.504(Ft.)

Average velocity of channel(s) = 12.509(Ft/s)

+++++
Process from Point/Station 1.011 to Point/Station 1.202
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1

Stream flow area = 58.200(Ac.)

Runoff from this stream = 99.927(CFS)

Time of concentration = 11.89 min.

Rainfall intensity = 4.897(In/Hr)

+++++
Process from Point/Station 1.171 to Point/Station 1.181
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[UNDISTURBED NATURAL TERRAIN]
(Permanent Open Space)
Impervious value, Ai = 0.000
Sub-Area C Value = 0.300
Initial subarea total flow distance = 100.000(Ft.)
Highest elevation = 640.000(Ft.)
Lowest elevation = 630.000(Ft.)
Elevation difference = 10.000(Ft.) Slope = 10.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 10.00 %, in a development type of
Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration = 6.68 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3))]
TC = [1.8*(1.1-0.300)*(100.000^.5)/(10.000^(1/3))] = 6.68
Rainfall intensity (I) = 7.101(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.300
Subarea runoff = 0.213(CFS)
Total initial stream area = 0.100(Ac.)

+++++
Process from Point/Station 1.181 to Point/Station 1.202
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

Estimated mean flow rate at midpoint of channel = 1.676(CFS)
Depth of flow = 0.189(Ft.), Average velocity = 8.037(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :
Point number 'X' coordinate 'Y' coordinate
1 0.00 5.00
2 38.70 0.00
3 58.40 5.00

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 1.676(CFS)
' flow top width = 2.207(Ft.)
' velocity= 8.037(Ft/s)
' area = 0.209(Sq.Ft)
' Froude number = 4.608

Upstream point elevation = 630.000(Ft.)
Downstream point elevation = 530.000(Ft.)
Flow length = 360.000(Ft.)
Travel time = 0.75 min.
Time of concentration = 7.43 min.
Depth of flow = 0.189(Ft.)
Average velocity = 8.037(Ft/s)
Total irregular channel flow = 1.676(CFS)
Irregular channel normal depth above invert elev. = 0.189(Ft.)
Average velocity of channel(s) = 8.037(Ft/s)

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Adding area flow to channel
Rainfall intensity (I) = 6.632(In/Hr) for a 100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[UNDISTURBED NATURAL TERRAIN]]
(Permanent Open Space)
Impervious value, Ai = 0.000
Sub-Area C Value = 0.300
Rainfall intensity = 6.632(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.300 CA = 0.465
Subarea runoff = 2.871(CFS) for 1.450(Ac.)
Total runoff = 3.084(CFS) Total area = 1.550(Ac.)
Depth of flow = 0.238(Ft.), Average velocity = 9.360(Ft/s)

+++++
Process from Point/Station 1.171 to Point/Station 1.202
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 1.550(Ac.)
Runoff from this stream = 3.084(CFS)
Time of concentration = 7.43 min.
Rainfall intensity = 6.632(In/Hr)

+++++
Process from Point/Station 1.191 to Point/Station 1.201
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL]]
(1.0 DU/A or Less)
Impervious value, Ai = 0.100
Sub-Area C Value = 0.360
Initial subarea total flow distance = 100.000(Ft.)
Highest elevation = 634.000(Ft.)
Lowest elevation = 625.000(Ft.)
Elevation difference = 9.000(Ft.) Slope = 9.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 9.00 %, in a development type of
1.0 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration = 6.40 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5]/(% slope^(1/3))
TC = [1.8*(1.1-0.3600)*(100.000^.5)/(9.000^(1/3))] = 6.40
Rainfall intensity (I) = 7.300(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.360
Subarea runoff = 0.526(CFS)

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Total initial stream area = 0.200(Ac.)

+++++
Process from Point/Station 1.201 to Point/Station 1.202
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

Estimated mean flow rate at midpoint of channel = 5.924(CFS)
Depth of flow = 0.367(Ft.), Average velocity = 7.656(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
| 1 | 0.00 | 5.00 |
| 2 | 32.00 | 0.00 |
| 3 | 57.40 | 5.00 |

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 5.924(CFS)
' ' flow top width = 4.215(Ft.)
' ' velocity= 7.656(Ft/s)
' ' area = 0.774(Sq.Ft)
' ' Froude number = 3.149

Upstream point elevation = 625.000(Ft.)

Downstream point elevation = 530.000(Ft.)

Flow length = 915.000(Ft.)

Travel time = 1.99 min.

Time of concentration = 8.40 min.

Depth of flow = 0.367(Ft.)

Average velocity = 7.656(Ft/s)

Total irregular channel flow = 5.924(CFS)

Irregular channel normal depth above invert elev. = 0.367(Ft.)

Average velocity of channel(s) = 7.656(Ft/s)

Adding area flow to channel

Rainfall intensity (I) = 6.130(In/Hr) for a 100.0 year storm

Decimal fraction soil group A = 0.000

Decimal fraction soil group B = 0.000

Decimal fraction soil group C = 1.000

Decimal fraction soil group D = 0.000

[UNDISTURBED NATURAL TERRAIN]

(Permanent Open Space)

Impervious value, Ai = 0.000

Sub-Area C Value = 0.300

Rainfall intensity = 6.130(In/Hr) for a 100.0 year storm

Effective runoff coefficient used for total area

(Q=KCIA) is C = 0.302 CA = 1.833

Subarea runoff = 10.710(CFS) for 5.870(Ac.)

Total runoff = 11.236(CFS) Total area = 6.070(Ac.)

Depth of flow = 0.467(Ft.), Average velocity = 8.984(Ft/s)

+++++
Process from Point/Station 1.191 to Point/Station 1.202
**** CONFLUENCE OF MINOR STREAMS ****

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Along Main Stream number: 1 in normal stream number 3

Stream flow area = 6.070(Ac.)

Runoff from this stream = 11.236(CFS)

Time of concentration = 8.40 min.

Rainfall intensity = 6.130(In/Hr)

Summary of stream data:

| Stream No. | Flow rate (CFS) | TC (min) | Rainfall Intensity (In/Hr) |
|------------|-----------------|----------|----------------------------|
|------------|-----------------|----------|----------------------------|

1 99.927 11.89 4.897

2 3.084 7.43 6.632

3 11.236 8.40 6.130

$Q_{max}(1) =$

$$\begin{aligned} 1.000 * & \quad 1.000 * \quad 99.927) + \\ 0.738 * & \quad 1.000 * \quad 3.084) + \\ 0.799 * & \quad 1.000 * \quad 11.236) + = \quad 111.181 \end{aligned}$$

$Q_{max}(2) =$

$$\begin{aligned} 1.000 * & \quad 0.625 * \quad 99.927) + \\ 1.000 * & \quad 1.000 * \quad 3.084) + \\ 1.000 * & \quad 0.885 * \quad 11.236) + = \quad 75.475 \end{aligned}$$

$Q_{max}(3) =$

$$\begin{aligned} 1.000 * & \quad 0.706 * \quad 99.927) + \\ 0.924 * & \quad 1.000 * \quad 3.084) + \\ 1.000 * & \quad 1.000 * \quad 11.236) + = \quad 84.644 \end{aligned}$$

Total of 3 streams to confluence:

Flow rates before confluence point:

99.927 3.084 11.236

Maximum flow rates at confluence using above data:

111.181 75.475 84.644

Area of streams before confluence:

58.200 1.550 6.070

Results of confluence:

Total flow rate = 111.181(CFS)

Time of concentration = 11.890 min.

Effective stream area after confluence = 65.820(Ac.)

+++++
Process from Point/Station 1.202 to Point/Station 1.242

***** IRREGULAR CHANNEL FLOW TRAVEL TIME *****

Depth of flow = 1.710(Ft.), Average velocity = 10.771(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
|--------------|----------------|----------------|

| | | |
|---|-------|------|
| 1 | 0.00 | 5.00 |
| 2 | 19.10 | 0.00 |
| 3 | 35.30 | 5.00 |

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 111.181(CFS)
flow top width = 12.073(Ft.)

**PRELIMINARY HYDROLOGY STUDY
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' ' velocity= 10.771(Ft/s)
' ' area = 10.322(Sq.Ft)
' ' Froude number = 2.053

Upstream point elevation = 530.000(Ft.)
Downstream point elevation = 527.000(Ft.)
Flow length = 110.000(Ft.)
Travel time = 0.17 min.
Time of concentration = 12.06 min.
Depth of flow = 1.710(Ft.)
Average velocity = 10.771(Ft/s)
Total irregular channel flow = 111.181(CFS)
Irregular channel normal depth above invert elev. = 1.710(Ft.)
Average velocity of channel(s) = 10.771(Ft/s)

+++++
Process from Point/Station 1.011 to Point/Station 1.242
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 65.820(Ac.)
Runoff from this stream = 111.181(CFS)
Time of concentration = 12.06 min.
Rainfall intensity = 4.853(In/Hr)

+++++
Process from Point/Station 1.211 to Point/Station 1.221
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[UNDISTURBED NATURAL TERRAIN]
(Permanent Open Space)
Impervious value, Ai = 0.000
Sub-Area C Value = 0.300
Initial subarea total flow distance = 100.000(Ft.)
Highest elevation = 619.000(Ft.)
Lowest elevation = 600.000(Ft.)
Elevation difference = 19.000(Ft.) Slope = 19.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 19.00 %, in a development type of
Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration = 5.40 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^0.5]/(% slope^(1/3))
TC = [1.8*(1.1-0.300)*(100.000^0.5)/(19.000^(1/3))] = 5.40
Rainfall intensity (I) = 8.152(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.300
Subarea runoff = 0.416(CFS)
Total initial stream area = 0.170(Ac.)

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

+++++
Process from Point/Station 1.221 to Point/Station 1.242
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

Estimated mean flow rate at midpoint of channel = 1.076(CFS)
Depth of flow = 0.157(Ft.), Average velocity = 8.804(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
| 1 | 0.00 | 5.00 |
| 2 | 29.40 | 0.00 |
| 3 | 49.60 | 5.00 |

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 1.076(CFS)
| flow top width = 1.557(Ft.)
| velocity= 8.804(Ft/s)
| area = 0.122(Sq.Ft)
| Froude number = 5.538

Upstream point elevation = 600.000(Ft.)

Downstream point elevation = 527.000(Ft.)

Flow length = 170.000(Ft.)

Travel time = 0.32 min.

Time of concentration = 5.72 min.

Depth of flow = 0.157(Ft.)

Average velocity = 8.804(Ft/s)

Total irregular channel flow = 1.076(CFS)

Irregular channel normal depth above invert elev. = 0.157(Ft.)

Average velocity of channel(s) = 8.804(Ft/s)

Adding area flow to channel

Rainfall intensity (I) = 7.853(In/Hr) for a 100.0 year storm

Decimal fraction soil group A = 0.000

Decimal fraction soil group B = 0.000

Decimal fraction soil group C = 1.000

Decimal fraction soil group D = 0.000

[UNDISTURBED NATURAL TERRAIN]

(Permanent Open Space)

Impervious value, Ai = 0.000

Sub-Area C Value = 0.300

Rainfall intensity = 7.853(In/Hr) for a 100.0 year storm

Effective runoff coefficient used for total area

(Q=KCIA) is C = 0.300 CA = 0.213

Subarea runoff = 1.257(CFS) for 0.540(Ac.)

Total runoff = 1.673(CFS) Total area = 0.710(Ac.)

Depth of flow = 0.185(Ft.), Average velocity = 9.830(Ft/s)

+++++
Process from Point/Station 1.211 to Point/Station 1.242
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2

Stream flow area = 0.710(Ac.)

**PRELIMINARY HYDROLOGY STUDY
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Runoff from this stream = 1.673(CFS)
Time of concentration = 5.72 min.
Rainfall intensity = 7.853(In/Hr)

+++++
Process from Point/Station 1.231 to Point/Station 1.241
***** INITIAL AREA EVALUATION *****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[UNDISTURBED NATURAL TERRAIN]
(Permanent Open Space)
Impervious value, Ai = 0.000
Sub-Area C Value = 0.300
Initial subarea total flow distance = 100.000(Ft.)
Highest elevation = 639.000(Ft.)
Lowest elevation = 635.000(Ft.)
Elevation difference = 4.000(Ft.) Slope = 4.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 4.00 %, in a development type of
Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration = 9.07 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.300)*(100.000^.5)/(4.000^(1/3)]= 9.07
Rainfall intensity (I) = 5.831(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.300
Subarea runoff = 0.245(CFS)
Total initial stream area = 0.140(Ac.)

+++++
Process from Point/Station 1.241 to Point/Station 1.242
***** IRREGULAR CHANNEL FLOW TRAVEL TIME *****

Estimated mean flow rate at midpoint of channel = 5.843(CFS)
Depth of flow = 0.460(Ft.), Average velocity = 9.202(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :
Point number 'X' coordinate 'Y' coordinate
1 0.00 5.00
2 15.10 0.00
3 30.00 5.00

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 5.843(CFS)
' flow top width = 2.760(Ft.)
' velocity= 9.202(Ft/s)
' area = 0.635(Sq.Ft)
' Froude number = 3.381

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
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Upstream point elevation = 635.000(Ft.)
Downstream point elevation = 527.000(Ft.)
Flow length = 925.000(Ft.)
Travel time = 1.68 min.
Time of concentration = 10.75 min.
Depth of flow = 0.460(Ft.)
Average velocity = 9.202(Ft/s)
Total irregular channel flow = 5.843(CFS)
Irregular channel normal depth above invert elev. = 0.460(Ft.)
Average velocity of channel(s) = 9.202(Ft/s)
Adding area flow to channel
Rainfall intensity (I) = 5.227(In/Hr) for a 100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[UNDISTURBED NATURAL TERRAIN]
(Permanent Open Space)
Impervious value, Ai = 0.000
Sub-Area C Value = 0.300
Rainfall intensity = 5.227(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.300 CA = 2.172
Subarea runoff = 11.109(CFS) for 7.100(Ac.)
Total runoff = 11.354(CFS) Total area = 7.240(Ac.)
Depth of flow = 0.590(Ft.), Average velocity = 10.865(Ft/s)

+++++
Process from Point/Station 1.231 to Point/Station 1.242
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 3
Stream flow area = 7.240(Ac.)
Runoff from this stream = 11.354(CFS)
Time of concentration = 10.75 min.
Rainfall intensity = 5.227(In/Hr)
Summary of stream data:

| Stream No. | Flow rate (CFS) | TC (min) | Rainfall Intensity (In/Hr) |
|------------|-----------------|----------|----------------------------|
| 1 | 111.181 | 12.06 | 4.853 |
| 2 | 1.673 | 5.72 | 7.853 |
| 3 | 11.354 | 10.75 | 5.227 |

Qmax(1) =
1.000 * 1.000 * 111.181) +
0.618 * 1.000 * 1.673) +
0.928 * 1.000 * 11.354) + = 122.755

Qmax(2) =
1.000 * 0.474 * 111.181) +
1.000 * 1.000 * 1.673) +
1.000 * 0.532 * 11.354) + = 60.429

Qmax(3) =
1.000 * 0.891 * 111.181) +

**PRELIMINARY HYDROLOGY STUDY
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0.666 * 1.000 * 1.673) +
1.000 * 1.000 * 11.354) + = 111.538

Total of 3 streams to confluence:

Flow rates before confluence point:

111.181 1.673 11.354

Maximum flow rates at confluence using above data:

122.755 60.429 111.538

Area of streams before confluence:

65.820 0.710 7.240

Results of confluence:

Total flow rate = 122.755(CFS)

Time of concentration = 12.060 min.

Effective stream area after confluence = 73.770(Ac.)

+++++
Process from Point/Station 1.242 to Point/Station 1.251

***** IRREGULAR CHANNEL FLOW TRAVEL TIME *****

Depth of flow = 1.915(Ft.), Average velocity = 9.484(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :

Point number 'X' coordinate 'Y' coordinate
1 0.00 5.00
2 19.10 0.00
3 35.30 5.00

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 122.755(CFS)
' flow top width = 13.519(Ft.)
' velocity= 9.484(Ft/s)
' area = 12.944(Sq.Ft)
' Froude number = 1.708

Upstream point elevation = 527.000(Ft.)

Downstream point elevation = 525.000(Ft.)

Flow length = 110.000(Ft.)

Travel time = 0.19 min.

Time of concentration = 12.25 min.

Depth of flow = 1.915(Ft.)

Average velocity = 9.484(Ft/s)

Total irregular channel flow = 122.755(CFS)

Irregular channel normal depth above invert elev. = 1.915(Ft.)

Average velocity of channel(s) = 9.484(Ft/s)

+++++
Process from Point/Station 1.251 to Point/Station 1.272

***** IRREGULAR CHANNEL FLOW TRAVEL TIME *****

Estimated mean flow rate at midpoint of channel = 122.797(CFS)

Depth of flow = 1.944(Ft.), Average velocity = 14.708(Ft/s)

***** Irregular Channel Data *****

**PRELIMINARY HYDROLOGY STUDY
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Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
| 1 | 0.00 | 5.00 |
| 2 | 9.70 | 0.00 |
| 3 | 22.10 | 5.00 |

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 122.796(CFS)

| | | |
|---|------------------|--------------|
| ' | flow top width = | 8.591(Ft.) |
| ' | velocity= | 14.708(Ft/s) |
| ' | area = | 8.349(Sq.Ft) |
| ' | Froude number = | 2.629 |

Upstream point elevation = 525.000(Ft.)

Downstream point elevation = 507.000(Ft.)

Flow length = 390.000(Ft.)

Travel time = 0.44 min.

Time of concentration = 12.70 min.

Depth of flow = 1.944(Ft.)

Average velocity = 14.708(Ft/s)

Total irregular channel flow = 122.797(CFS)

Irregular channel normal depth above invert elev. = 1.944(Ft.)

Average velocity of channel(s) = 14.708(Ft/s)

Adding area flow to channel

Rainfall intensity (I) = 4.695(In/Hr) for a 100.0 year storm

Decimal fraction soil group A = 0.000

Decimal fraction soil group B = 0.000

Decimal fraction soil group C = 1.000

Decimal fraction soil group D = 0.000

[UNDISTURBED NATURAL TERRAIN]

(Permanent Open Space)

Impervious value, Ai = 0.000

Sub-Area C Value = 0.300

The area added to the existing stream causes a

a lower flow rate of Q = 119.490(CFS)

therefore the upstream flow rate of Q = 122.755(CFS) is being used

Rainfall intensity = 4.695(In/Hr) for a 100.0 year storm

Effective runoff coefficient used for total area

(Q=KCIA) is C = 0.331 CA = 25.453

Subarea runoff = 0.000(CFS) for 3.230(Ac.)

Total runoff = 122.755(CFS) Total area = 77.000(Ac.)

Depth of flow = 1.943(Ft.), Average velocity = 14.707(Ft/s)

+++++
Process from Point/Station 1.011 to Point/Station 1.272

**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1

Stream flow area = 77.000(Ac.)

Runoff from this stream = 122.755(CFS)

Time of concentration = 12.70 min.

Rainfall intensity = 4.695(In/Hr)

+++++
+++++

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Process from Point/Station 1.261 to Point/Station 1.271
***** INITIAL AREA EVALUATION *****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[UNDISTURBED NATURAL TERRAIN]
(Permanent Open Space)
Impervious value, Ai = 0.000
Sub-Area C Value = 0.300
Initial subarea total flow distance = 100.000(Ft.)
Highest elevation = 667.000(Ft.)
Lowest elevation = 662.000(Ft.)
Elevation difference = 5.000(Ft.) Slope = 5.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 5.00 %, in a development type of
Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration = 8.42 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.3000)*(100.000^.5)/(5.000^(1/3)]= 8.42
Rainfall intensity (I) = 6.118(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.300
Subarea runoff = 0.147(CFS)
Total initial stream area = 0.080(Ac.)

+++++
Process from Point/Station 1.271 to Point/Station 1.272
***** IRREGULAR CHANNEL FLOW TRAVEL TIME *****

Estimated mean flow rate at midpoint of channel = 6.849(CFS)
Depth of flow = 0.529(Ft.), Average velocity = 10.652(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :
Point number 'X' coordinate 'Y' coordinate
1 0.00 5.00
2 11.40 0.00
3 23.00 5.00

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 6.850(CFS)
' flow top width = 2.432(Ft.)
' velocity= 10.652(Ft/s)
' area = 0.643(Sq.Ft)
' Froude number = 3.651

Upstream point elevation = 662.000(Ft.)
Downstream point elevation = 507.000(Ft.)
Flow length = 1140.000(Ft.)
Travel time = 1.78 min.
Time of concentration = 10.20 min.
Depth of flow = 0.529(Ft.)

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Average velocity = 10.652(Ft/s)
Total irregular channel flow = 6.849(CFS)
Irregular channel normal depth above invert elev. = 0.529(Ft.)
Average velocity of channel(s) = 10.652(Ft/s)
Adding area flow to channel
Rainfall intensity (I) = 5.405(In/Hr) for a 100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[UNDISTURBED NATURAL TERRAIN]
(Permanent Open Space)
Impervious value, Ai = 0.000
Sub-Area C Value = 0.300
Rainfall intensity = 5.405(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.300 CA = 2.496
Subarea runoff = 13.343(CFS) for 8.240(Ac.)
Total runoff = 13.490(CFS) Total area = 8.320(Ac.)
Depth of flow = 0.682(Ft.), Average velocity = 12.619(Ft/s)

+++++
Process from Point/Station 1.261 to Point/Station 1.272
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 8.320(Ac.)
Runoff from this stream = 13.490(CFS)
Time of concentration = 10.20 min.
Rainfall intensity = 5.405(In/Hr)
Summary of stream data:

| Stream No. | Flow rate (CFS) | TC (min) | Rainfall Intensity (In/Hr) |
|------------|-----------------|--------------------|--------------------------------|
| 1 | 122.755 | 12.70 | 4.695 |
| 2 | 13.490 | 10.20 | 5.405 |
| Qmax(1) = | 1.000 * 0.869 * | 122.755) + 13.490) | 122.755) + 13.490) + = 134.472 |
| Qmax(2) = | 1.000 * 1.000 * | 122.755) + 13.490) | 122.755) + 13.490) + = 112.161 |

Total of 2 streams to confluence:
Flow rates before confluence point:
122.755 13.490
Maximum flow rates at confluence using above data:
134.472 112.161
Area of streams before confluence:
77.000 8.320
Results of confluence:
Total flow rate = 134.472(CFS)
Time of concentration = 12.696 min.

**PRELIMINARY HYDROLOGY STUDY
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Effective stream area after confluence = 85.320(Ac.)

+++++
Process from Point/Station 1.272 to Point/Station 1.292
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

Depth of flow = 1.469(Ft.), Average velocity = 11.953(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
| 1 | 0.00 | 5.00 |
| 2 | 23.90 | 0.00 |
| 3 | 52.10 | 5.00 |

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 134.472(CFS)
' ' flow top width = 15.312(Ft.)
' ' velocity= 11.953(Ft/s)
' ' area = 11.250(Sq.Ft)
' ' Froude number = 2.458

Upstream point elevation = 507.000(Ft.)
Downstream point elevation = 499.000(Ft.)
Flow length = 200.000(Ft.)
Travel time = 0.28 min.
Time of concentration = 12.97 min.
Depth of flow = 1.469(Ft.)
Average velocity = 11.953(Ft/s)
Total irregular channel flow = 134.472(CFS)
Irregular channel normal depth above invert elev. = 1.469(Ft.)
Average velocity of channel(s) = 11.953(Ft/s)

+++++
Process from Point/Station 1.011 to Point/Station 1.292
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 85.320(Ac.)
Runoff from this stream = 134.472(CFS)
Time of concentration = 12.97 min.
Rainfall intensity = 4.629(In/Hr)

+++++
Process from Point/Station 1.281 to Point/Station 1.291
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[UNDISTURBED NATURAL TERRAIN]
(Permanent Open Space)

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Impervious value, $A_i = 0.000$
Sub-Area C Value = 0.300
Initial subarea total flow distance = 100.000(Ft.)
Highest elevation = 642.000(Ft.)
Lowest elevation = 632.000(Ft.)
Elevation difference = 10.000(Ft.) Slope = 10.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 10.00 %, in a development type of
Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration = 6.68 minutes
 $TC = [1.8 * (1.1 - C) * distance(Ft.)^{0.5}] / (% slope^{(1/3)})$
 $TC = [1.8 * (1.1 - 0.300) * (100.000^{0.5}) / (10.000^{(1/3)})] = 6.68$
Rainfall intensity (I) = 7.101(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.300
Subarea runoff = 0.852(CFS)
Total initial stream area = 0.400(Ac.)

+++++
Process from Point/Station 1.291 to Point/Station 1.292
***** IRREGULAR CHANNEL FLOW TRAVEL TIME *****

Estimated mean flow rate at midpoint of channel = 9.689(CFS)
Depth of flow = 0.458(Ft.), Average velocity = 11.182(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
| 1 | 0.00 | 5.00 |
| 2 | 18.30 | 3.00 |
| 3 | 37.30 | 2.00 |
| 4 | 47.30 | 0.00 |
| 5 | 60.40 | 4.00 |
| 6 | 80.10 | 5.00 |

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 9.689(CFS)
' ' flow top width = 3.787(Ft.)
' ' velocity= 11.182(Ft/s)
' ' area = 0.866(Sq.Ft)
' ' Froude number = 4.120

Upstream point elevation = 632.000(Ft.)
Downstream point elevation = 499.000(Ft.)
Flow length = 790.000(Ft.)
Travel time = 1.18 min.
Time of concentration = 7.86 min.
Depth of flow = 0.458(Ft.)
Average velocity = 11.182(Ft/s)
Total irregular channel flow = 9.689(CFS)
Irregular channel normal depth above invert elev. = 0.458(Ft.)
Average velocity of channel(s) = 11.182(Ft/s)
Adding area flow to channel
Rainfall intensity (I) = 6.395(In/Hr) for a 100.0 year storm

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[UNDISTURBED NATURAL TERRAIN]
(Permanent Open Space)
Impervious value, Ai = 0.000
Sub-Area C Value = 0.300
Rainfall intensity = 6.395(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.300 CA = 2.886
Subarea runoff = 17.605(CFS) for 9.220(Ac.)
Total runoff = 18.457(CFS) Total area = 9.620(Ac.)
Depth of flow = 0.583(Ft.), Average velocity = 13.137(Ft/s)

+++++
Process from Point/Station 1.281 to Point/Station 1.292
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 9.620(Ac.)
Runoff from this stream = 18.457(CFS)
Time of concentration = 7.86 min.
Rainfall intensity = 6.395(In/Hr)
Summary of stream data:

| Stream No. | Flow rate (CFS) | TC (min) | Rainfall Intensity (In/Hr) |
|------------|-----------------|---------------------|----------------------------|
| 1 | 134.472 | 12.97 | 4.629 |
| 2 | 18.457 | 7.86 | 6.395 |
| Qmax(1) = | 1.000 * | 1.000 * 134.472) + | |
| | 0.724 * | 1.000 * 18.457) + = | 147.832 |
| Qmax(2) = | 1.000 * | 0.606 * 134.472) + | |
| | 1.000 * | 1.000 * 18.457) + = | 99.935 |

Total of 2 streams to confluence:
Flow rates before confluence point:
134.472 18.457
Maximum flow rates at confluence using above data:
147.832 99.935
Area of streams before confluence:
85.320 9.620
Results of confluence:
Total flow rate = 147.832(CFS)
Time of concentration = 12.975 min.
Effective stream area after confluence = 94.940(Ac.)

+++++
Process from Point/Station 1.292 to Point/Station 1.312
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Depth of flow = 1.734(Ft.), Average velocity = 9.438(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
| 1 | 0.00 | 5.00 |
| 2 | 23.90 | 0.00 |
| 3 | 52.10 | 5.00 |

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 147.832(CFS)
| flow top width = 18.067(Ft.)
| velocity= 9.438(Ft/s)
| area = 15.663(Sq.Ft)
| Froude number = 1.786

Upstream point elevation = 499.000(Ft.)

Downstream point elevation = 494.000(Ft.)

Flow length = 250.000(Ft.)

Travel time = 0.44 min.

Time of concentration = 13.42 min.

Depth of flow = 1.734(Ft.)

Average velocity = 9.438(Ft/s)

Total irregular channel flow = 147.832(CFS)

Irregular channel normal depth above invert elev. = 1.734(Ft.)

Average velocity of channel(s) = 9.438(Ft/s)

+++++
Process from Point/Station 1.011 to Point/Station 1.312
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1

Stream flow area = 94.940(Ac.)

Runoff from this stream = 147.832(CFS)

Time of concentration = 13.42 min.

Rainfall intensity = 4.530(In/Hr)

+++++
Process from Point/Station 1.301 to Point/Station 1.311
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000

Decimal fraction soil group B = 0.000

Decimal fraction soil group C = 1.000

Decimal fraction soil group D = 0.000

[UNDISTURBED NATURAL TERRAIN]

(Permanent Open Space)

Impervious value, Ai = 0.000

Sub-Area C Value = 0.300

Initial subarea total flow distance = 100.000(Ft.)

Highest elevation = 587.000(Ft.)

Lowest elevation = 582.000(Ft.)

Elevation difference = 5.000(Ft.) Slope = 5.000 %

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:

The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 5.00 %, in a development type of
Permanent Open Space

In Accordance With Figure 3-3

Initial Area Time of Concentration = 8.42 minutes

TC = [1.8*(1.1-C)*distance(Ft.)^{.5}]/(% slope^(1/3))

TC = [1.8*(1.1-0.3000)*(100.000^{.5})/(5.000^(1/3))]= 8.42

Rainfall intensity (I) = 6.118(In/Hr) for a 100.0 year storm

Effective runoff coefficient used for area (Q=KCIA) is C = 0.300

Subarea runoff = 0.422(CFS)

Total initial stream area = 0.230(Ac.)

+++++
Process from Point/Station 1.311 to Point/Station 1.312
***** IRREGULAR CHANNEL FLOW TRAVEL TIME *****

Estimated mean flow rate at midpoint of channel = 3.581(CFS)

Depth of flow = 0.175(Ft.), Average velocity = 5.953(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
| 1 | 0.00 | 2.00 |
| 2 | 27.00 | 0.00 |
| 3 | 78.90 | 2.00 |

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 3.581(CFS)
' ' flow top width = 6.889(Ft.)
' ' velocity= 5.953(Ft/s)
' ' area = 0.602(Sq.Ft)
' ' Froude number = 3.550

Upstream point elevation = 582.000(Ft.)

Downstream point elevation = 494.000(Ft.)

Flow length = 530.000(Ft.)

Travel time = 1.48 min.

Time of concentration = 9.90 min.

Depth of flow = 0.175(Ft.)

Average velocity = 5.953(Ft/s)

Total irregular channel flow = 3.581(CFS)

Irregular channel normal depth above invert elev. = 0.175(Ft.)

Average velocity of channel(s) = 5.953(Ft/s)

Adding area flow to channel

Rainfall intensity (I) = 5.510(In/Hr) for a 100.0 year storm

Decimal fraction soil group A = 0.000

Decimal fraction soil group B = 0.000

Decimal fraction soil group C = 1.000

Decimal fraction soil group D = 0.000

[UNDISTURBED NATURAL TERRAIN]

(Permanent Open Space)

Impervious value, Ai = 0.000

Sub-Area C Value = 0.300

Rainfall intensity = 5.510(In/Hr) for a 100.0 year storm

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.300 CA = 1.206
Subarea runoff = 6.223(CFS) for 3.790(Ac.)
Total runoff = 6.645(CFS) Total area = 4.020(Ac.)
Depth of flow = 0.220(Ft.), Average velocity = 6.948(Ft/s)

+++++
Process from Point/Station 1.301 to Point/Station 1.312
***** CONFLUENCE OF MINOR STREAMS *****

Along Main Stream number: 1 in normal stream number 2

Stream flow area = 4.020(Ac.)
Runoff from this stream = 6.645(CFS)
Time of concentration = 9.90 min.
Rainfall intensity = 5.510(In/Hr)
Summary of stream data:

| Stream No. | Flow rate (CFS) | TC (min) | Rainfall Intensity (In/Hr) |
|------------|-----------------|--------------------|----------------------------|
| 1 | 147.832 | 13.42 | 4.530 |
| 2 | 6.645 | 9.90 | 5.510 |
| Qmax(1) = | | | |
| | 1.000 * | 1.000 * 147.832) + | |
| | 0.822 * | 1.000 * 6.645) + = | 153.296 |
| Qmax(2) = | | | |
| | 1.000 * | 0.738 * 147.832) + | |
| | 1.000 * | 1.000 * 6.645) + = | 115.789 |

Total of 2 streams to confluence:

Flow rates before confluence point:

147.832 6.645
Maximum flow rates at confluence using above data:

153.296 115.789

Area of streams before confluence:

94.940 4.020

Results of confluence:

Total flow rate = 153.296(CFS)
Time of concentration = 13.416 min.
Effective stream area after confluence = 98.960(Ac.)

+++++
Process from Point/Station 1.312 to Point/Station 1.313
***** IRREGULAR CHANNEL FLOW TRAVEL TIME *****

Depth of flow = 1.626(Ft.), Average velocity = 14.985(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
| 1 | 0.00 | 5.00 |
| 2 | 17.20 | 0.00 |
| 3 | 38.70 | 5.00 |

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 153.296(CFS)
' ' flow top width = 12.584(Ft.)
' ' velocity= 14.985(Ft/s)
' ' area = 10.230(Sq.Ft)
' ' Froude number = 2.929

Upstream point elevation = 494.000(Ft.)
Downstream point elevation = 487.000(Ft.)
Flow length = 125.000(Ft.)
Travel time = 0.14 min.
Time of concentration = 13.56 min.
Depth of flow = 1.626(Ft.)
Average velocity = 14.985(Ft/s)
Total irregular channel flow = 153.296(CFS)
Irregular channel normal depth above invert elev. = 1.626(Ft.)
Average velocity of channel(s) = 14.985(Ft/s)

+++++
Process from Point/Station 1.011 to Point/Station 1.313
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:

In Main Stream number: 1
Stream flow area = 98.960(Ac.)
Runoff from this stream = 153.296(CFS)
Time of concentration = 13.56 min.
Rainfall intensity = 4.500(In/Hr)
Summary of stream data:

| Stream No. | Flow rate (CFS) | TC (min) | Rainfall Intensity (In/Hr) |
|------------|-----------------|--------------|----------------------------|
| 1 | 153.296 | 13.56 | 4.500 |
| Qmax(1) = | | | |
| | 1.000 * 1.000 * | 153.296) + = | 153.296 |

Total of 1 main streams to confluence:

Flow rates before confluence point:

153.296

Maximum flow rates at confluence using above data:

153.296

Area of streams before confluence:

98.960

Results of confluence:

Total flow rate = 153.296(CFS)
Time of concentration = 13.555 min.
Effective stream area after confluence = 98.960(Ac.)
End of computations, total study area = 98.960 (Ac.)

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

ATTACHMENT 3: PROPOSED CONDITIONS CALCULATIONS

100-YEAR DESIGN STORM EVENT

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software, (c)1991-2006 Version 7.7

Rational method hydrology program based on
San Diego County Flood Control Division 2003 hydrology manual
Rational Hydrology Study Date: 03/04/09

REDDING MINOR SUBDIVISION
TPM 21112
PRELIMINARY HYDROLOGY STUDY 100-YEAR DESIGN STORM EVENT
WEI 08-116, RJR, 3-4-09

***** Hydrology Study Control Information *****

Program License Serial Number 6170

Rational hydrology study storm event year is 100.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour, precipitation(inches) = 3.250
24 hour precipitation(inches) = 5.750
P6/P24 = 56.5%
San Diego hydrology manual 'C' values used

+++++
Process from Point/Station 1.011 to Point/Station 1.021
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL]
(1.0 DU/A or Less)
Impervious value, Ai = 0.100
Sub-Area C Value = 0.360
Initial subarea total flow distance = 100.000(Ft.)
Highest elevation = 760.000(Ft.)
Lowest elevation = 753.000(Ft.)
Elevation difference = 7.000(Ft.) Slope = 7.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 7.00 %, in a development type of
1.0 DU/A or Less
In Accordance With Figure 3-3

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Initial Area Time of Concentration = 6.96 minutes
TC = $[1.8 * (1.1 - C) * \text{distance(Ft.)}^{0.5}] / (\% \text{ slope}^{(1/3)})$
TC = $[1.8 * (1.1 - 0.360) * (100.000^{0.5})] / (7.000^{(1/3)}) = 6.96$
Rainfall intensity (I) = 6.916 (In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.360
Subarea runoff = 0.772 (CFS)
Total initial stream area = 0.310 (Ac.)

+++++
Process from Point/Station 1.021 to Point/Station 1.042
***** IRREGULAR CHANNEL FLOW TRAVEL TIME *****

Estimated mean flow rate at midpoint of channel = 9.559 (CFS)
Depth of flow = 0.453 (Ft.), Average velocity = 9.184 (Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
| 1 | 0.00 | 5.00 |
| 2 | 18.20 | 0.00 |
| 3 | 50.80 | 5.00 |

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 9.559 (CFS)
' ' flow top width = 4.599 (Ft.)
' ' velocity = 9.184 (Ft/s)
' ' area = 1.041 (Sq.Ft.)
' ' Froude number = 3.402

Upstream point elevation = 753.000 (Ft.)
Downstream point elevation = 617.500 (Ft.)
Flow length = 1190.000 (Ft.)
Travel time = 2.16 min.
Time of concentration = 9.12 min.
Depth of flow = 0.453 (Ft.)
Average velocity = 9.184 (Ft/s)
Total irregular channel flow = 9.559 (CFS)
Irregular channel normal depth above invert elev. = 0.453 (Ft.)
Average velocity of channel(s) = 9.184 (Ft/s)
Adding area flow to channel
Rainfall intensity (I) = 5.810 (In/Hr) for a 100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL]
(1.0 DU/A or Less)
Impervious value, Ai = 0.100
Sub-Area C Value = 0.360
Rainfall intensity = 5.810 (In/Hr) for a 100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.360 CA = 3.146
Subarea runoff = 17.509 (CFS) for 8.430 (Ac.)
Total runoff = 18.281 (CFS) Total area = 8.740 (Ac.)
Depth of flow = 0.577 (Ft.), Average velocity = 10.800 (Ft/s)

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

+++++
Process from Point/Station 1.011 to Point/Station 1.042
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 8.740(Ac.)
Runoff from this stream = 18.281(CFS)
Time of concentration = 9.12 min.
Rainfall intensity = 5.810(In/Hr)

+++++
Process from Point/Station 1.031 to Point/Station 1.041
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL]
(1.0 DU/A or Less)
Impervious value, Ai = 0.100
Sub-Area C Value = 0.360
Initial subarea total flow distance = 100.000(Ft.)
Highest elevation = 694.000(Ft.)
Lowest elevation = 679.000(Ft.)
Elevation difference = 15.000(Ft.) Slope = 15.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 15.00 %, in a development type of
1.0 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration = 5.40 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^0.5]/(% slope^(1/3))
TC = [1.8*(1.1-0.3600)*(100.000^0.5)/(15.000^(1/3))] = 5.40
Rainfall intensity (I) = 8.147(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.360
Subarea runoff = 1.349(CFS)
Total initial stream area = 0.460(Ac.)

+++++
Process from Point/Station 1.041 to Point/Station 1.042
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

Estimated mean flow rate at midpoint of channel = 5.810(CFS)
Depth of flow = 0.289(Ft.), Average velocity = 7.572(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :
Point number 'X' coordinate 'Y' coordinate
1 0.00 2.50
2 21.70 0.00
3 46.00 2.50

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 5.810(CFS)
' ' flow top width = 5.314(Ft.)
' ' velocity= 7.573(Ft/s)
' ' area = 0.767(Sq.Ft)
' ' Froude number = 3.512

Upstream point elevation = 679.000(Ft.)

Downstream point elevation = 617.500(Ft.)

Flow length = 445.000(Ft.)

Travel time = 0.98 min.

Time of concentration = 6.38 min.

Depth of flow = 0.289(Ft.)

Average velocity = 7.572(Ft/s)

Total irregular channel flow = 5.810(CFS)

Irregular channel normal depth above invert elev. = 0.289(Ft.)

Average velocity of channel(s) = 7.572(Ft/s)

Adding area flow to channel

Rainfall intensity (I) = 7.317(In/Hr) for a 100.0 year storm

Decimal fraction soil group A = 0.000

Decimal fraction soil group B = 0.000

Decimal fraction soil group C = 1.000

Decimal fraction soil group D = 0.000

[LOW DENSITY RESIDENTIAL

]

(1.0 DU/A or Less)

Impervious value, Ai = 0.100

Sub-Area C Value = 0.360

Rainfall intensity = 7.317(In/Hr) for a 100.0 year storm

Effective runoff coefficient used for total area

(Q=KCIA) is C = 0.360 CA = 1.393

Subarea runoff = 8.845(CFS) for 3.410(Ac.)

Total runoff = 10.194(CFS) Total area = 3.870(Ac.)

Depth of flow = 0.357(Ft.), Average velocity = 8.715(Ft/s)

+++++
Process from Point/Station 1.031 to Point/Station 1.042

**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2

Stream flow area = 3.870(Ac.)

Runoff from this stream = 10.194(CFS)

Time of concentration = 6.38 min.

Rainfall intensity = 7.317(In/Hr)

Summary of stream data:

| Stream No. | Flow rate (CFS) | TC (min) | Rainfall Intensity (In/Hr) |
|------------|-----------------|----------|----------------------------|
| 1 | 18.281 | 9.12 | 5.810 |
| 2 | 10.194 | 6.38 | 7.317 |
| Qmax(1) = | 1.000 * | 1.000 * | 18.281) + |
| | 0.794 * | 1.000 * | 10.194) + = 26.375 |

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

$Q_{max}(2) =$
1.000 * 0.699 * 18.281) +
1.000 * 1.000 * 10.194) + = 22.980

Total of 2 streams to confluence:

Flow rates before confluence point:
18.281 10.194

Maximum flow rates at confluence using above data:
26.375 22.980

Area of streams before confluence:
8.740 3.870

Results of confluence:

Total flow rate = 26.375(CFS)

Time of concentration = 9.123 min.

Effective stream area after confluence = 12.610(Ac.)

+++++
Process from Point/Station 1.042 to Point/Station 1.072

***** IRREGULAR CHANNEL FLOW TRAVEL TIME *****

Estimated mean flow rate at midpoint of channel = 27.388(CFS)

Depth of flow = 0.677(Ft.), Average velocity = 13.048(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
| 1 | 0.00 | 5.00 |
| 2 | 18.60 | 0.00 |
| 3 | 45.80 | 5.00 |

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 27.388(CFS)

' flow top width = 6.201(Ft.)
' velocity= 13.048(Ft/s)
' area = 2.099(Sq.Ft)
' Froude number = 3.952

Upstream point elevation = 617.500(Ft.)

Downstream point elevation = 604.000(Ft.)

Flow length = 100.000(Ft.)

Travel time = 0.13 min.

Time of concentration = 9.25 min.

Depth of flow = 0.677(Ft.)

Average velocity = 13.048(Ft/s)

Total irregular channel flow = 27.388(CFS)

Irregular channel normal depth above invert elev. = 0.677(Ft.)

Average velocity of channel(s) = 13.048(Ft/s)

Adding area flow to channel

Rainfall intensity (I) = 5.758(In/Hr) for a 100.0 year storm

Decimal fraction soil group A = 0.000

Decimal fraction soil group B = 0.000

Decimal fraction soil group C = 1.000

Decimal fraction soil group D = 0.000

[LOW DENSITY RESIDENTIAL]

(1.0 DU/A or Less)

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Impervious value, $A_i = 0.100$
Sub-Area C Value = 0.360
Rainfall intensity = 5.758(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for total area
($Q=KCIA$) is $C = 0.360$ $CA = 4.921$
Subarea runoff = 1.962(CFS) for 1.060(Ac.)
Total runoff = 28.337(CFS) Total area = 13.670(Ac.)
Depth of flow = 0.686(Ft.), Average velocity = 13.160(Ft/s)

++++++
Process from Point/Station 1.011 to Point/Station 1.072
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 13.670(Ac.)
Runoff from this stream = 28.337(CFS)
Time of concentration = 9.25 min.
Rainfall intensity = 5.758(In/Hr)

++++++
Process from Point/Station 1.061 to Point/Station 1.071
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL]
(1.0 DU/A or Less)
Impervious value, $A_i = 0.100$
Sub-Area C Value = 0.360
Initial subarea total flow distance = 100.000(Ft.)
Highest elevation = 686.000(Ft.)
Lowest elevation = 679.000(Ft.)
Elevation difference = 7.000(Ft.) Slope = 7.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 7.00 %, in a development type of
1.0 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration = 6.96 minutes
 $TC = [1.8 * (1.1 - C) * distance(Ft.)^{.5}] / (% slope^{(1/3)})$
 $TC = [1.8 * (1.1 - 0.360) * (100.000^{.5}) / (7.000^{(1/3)})] = 6.96$
Rainfall intensity (I) = 6.916(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area ($Q=KCIA$) is $C = 0.360$
Subarea runoff = 0.548(CFS)
Total initial stream area = 0.220(Ac.)

++++++
Process from Point/Station 1.071 to Point/Station 1.072
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

Estimated mean flow rate at midpoint of channel = 3.378(CFS)

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Depth of flow = 0.297(Ft.), Average velocity = 8.041(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
| 1 | 0.00 | 5.00 |
| 2 | 22.20 | 0.00 |
| 3 | 47.50 | 5.00 |

Manning's 'N' friction factor = 0.020

| Sub-Channel flow | = | 3.378(CFS) |
|------------------|---|-----------------------------|
| ' | ' | flow top width = 2.825(Ft.) |
| ' | ' | velocity= 8.041(Ft/s) |
| ' | ' | area = 0.420(Sq.Ft) |
| ' | ' | Froude number = 3.675 |

Upstream point elevation = 679.000(Ft.)

Downstream point elevation = 604.000(Ft.)

Flow length = 490.000(Ft.)

Travel time = 1.02 min.

Time of concentration = 7.98 min.

Depth of flow = 0.297(Ft.)

Average velocity = 8.041(Ft/s)

Total irregular channel flow = 3.378(CFS)

Irregular channel normal depth above invert elev. = 0.297(Ft.)

Average velocity of channel(s) = 8.041(Ft/s)

Adding area flow to channel

Rainfall intensity (I) = 6.334(In/Hr) for a 100.0 year storm

Decimal fraction soil group A = 0.000

Decimal fraction soil group B = 0.000

Decimal fraction soil group C = 1.000

Decimal fraction soil group D = 0.000

[LOW DENSITY RESIDENTIAL]

(1.0 DU/A or Less)

Impervious value, Ai = 0.100

Sub-Area C Value = 0.360

Rainfall intensity = 6.334(In/Hr) for a 100.0 year storm

Effective runoff coefficient used for total area

(Q=KCIA) is C = 0.360 CA = 0.968

Subarea runoff = 5.587(CFS) for 2.470(Ac.)

Total runoff = 6.134(CFS) Total area = 2.690(Ac.)

Depth of flow = 0.372(Ft.), Average velocity = 9.334(Ft/s)

+++++
Process from Point/Station 1.061 to Point/Station 1.072

**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2

Stream flow area = 2.690(Ac.)

Runoff from this stream = 6.134(CFS)

Time of concentration = 7.98 min.

Rainfall intensity = 6.334(In/Hr)

Summary of stream data:

| Stream | Flow rate | TC | Rainfall Intensity |
|--------|-----------|----|--------------------|
|--------|-----------|----|--------------------|

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

| No. | (CFS) | (min) | (In/Hr) |
|-----------|-----------------|-----------------|-----------------------------|
| 1 | 28.337 | 9.25 | 5.758 |
| 2 | 6.134 | 7.98 | 6.334 |
| Qmax(1) = | | | |
| | 1.000 * 0.909 * | 1.000 * 1.000 * | 28.337) + 6.134) + = 33.913 |
| Qmax(2) = | | | |
| | 1.000 * 1.000 * | 0.863 * 1.000 * | 28.337) + 6.134) + = 30.576 |

Total of 2 streams to confluence:

Flow rates before confluence point:

28.337 6.134

Maximum flow rates at confluence using above data:

33.913 30.576

Area of streams before confluence:

13.670 2.690

Results of confluence:

Total flow rate = 33.913(CFS)

Time of concentration = 9.250 min.

Effective stream area after confluence = 16.360(Ac.)

+++++
Process from Point/Station 1.072 to Point/Station 1.146
***** IRREGULAR CHANNEL FLOW TRAVEL TIME *****

Estimated mean flow rate at midpoint of channel = 33.994(CFS)
Depth of flow = 0.990(Ft.), Average velocity = 9.772(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
| 1 | 0.00 | 5.00 |
| 2 | 16.70 | 0.00 |
| 3 | 35.50 | 5.00 |

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 33.994(CFS)
' ' flow top width = 7.028(Ft.)
' ' velocity= 9.772(Ft/s)
' ' area = 3.479(Sq.Ft)
' ' Froude number = 2.448

Upstream point elevation = 604.000(Ft.)

Downstream point elevation = 551.000(Ft.)

Flow length = 1140.000(Ft.)

Travel time = 1.94 min.

Time of concentration = 11.19 min.

Depth of flow = 0.990(Ft.)

Average velocity = 9.772(Ft/s)

Total irregular channel flow = 33.994(CFS)

Irregular channel normal depth above invert elev. = 0.990(Ft.)

Average velocity of channel(s) = 9.772(Ft/s)

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Adding area flow to channel
Rainfall intensity (I) = 5.091(In/Hr) for a 100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL]
(1.0 DU/A or Less)
Impervious value, Ai = 0.100
Sub-Area C Value = 0.360
Rainfall intensity = 5.091(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.360 CA = 6.678
Subarea runoff = 0.087(CFS) for 2.190(Ac.)
Total runoff = 34.001(CFS) Total area = 18.550(Ac.)
Depth of flow = 0.990(Ft.), Average velocity = 9.772(Ft/s)

+++++
Process from Point/Station 1.011 to Point/Station 1.146
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area = 18.550(Ac.)
Runoff from this stream = 34.001(CFS)
Time of concentration = 11.19 min.
Rainfall intensity = 5.091(In/Hr)
Program is now starting with Main Stream No. 2

+++++
Process from Point/Station 1.091 to Point/Station 1.101
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL]
(1.0 DU/A or Less)
Impervious value, Ai = 0.100
Sub-Area C Value = 0.360
Initial subarea total flow distance = 100.000(Ft.)
Highest elevation = 767.000(Ft.)
Lowest elevation = 757.000(Ft.)
Elevation difference = 10.000(Ft.) Slope = 10.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 10.00 %, in a development type of
1.0 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration = 6.18 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5]/(% slope^(1/3))
TC = [1.8*(1.1-0.360)*(100.000^.5)/(10.000^(1/3))]= 6.18
Rainfall intensity (I) = 7.467(In/Hr) for a 100.0 year storm

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Effective runoff coefficient used for area (Q=KCIA) is C = 0.360
Subarea runoff = 0.565(CFS)
Total initial stream area = 0.210(Ac.)

+++++
Process from Point/Station 1.101 to Point/Station 1.146
***** IRREGULAR CHANNEL FLOW TRAVEL TIME *****

Estimated mean flow rate at midpoint of channel = 13.847(CFS)
Depth of flow = 0.502(Ft.), Average velocity = 9.985(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :
Point number 'X' coordinate 'Y' coordinate
1 0.00 5.00
2 17.10 0.00
3 55.10 5.00
Manning's 'N' friction factor = 0.020

Sub-Channel flow = 13.847(CFS)
' flow top width = 5.529(Ft.)
' velocity= 9.985(Ft/s)
' area = 1.387(Sq.Ft)
' Froude number = 3.513

Upstream point elevation = 757.000(Ft.)
Downstream point elevation = 551.000(Ft.)
Flow length = 1760.000(Ft.)
Travel time = 2.94 min.
Time of concentration = 9.12 min.
Depth of flow = 0.502(Ft.)
Average velocity = 9.985(Ft/s)
Total irregular channel flow = 13.847(CFS)
Irregular channel normal depth above invert elev. = 0.502(Ft.)
Average velocity of channel(s) = 9.985(Ft/s)

Adding area flow to channel
Rainfall intensity (I) = 5.811(In/Hr) for a 100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL]
(1.0 DU/A or Less)
Impervious value, Ai = 0.100
Sub-Area C Value = 0.360
Rainfall intensity = 5.811(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.360 CA = 4.655
Subarea runoff = 26.484(CFS) for 12.720(Ac.)
Total runoff = 27.049(CFS) Total area = 12.930(Ac.)
Depth of flow = 0.645(Ft.), Average velocity = 11.804(Ft/s)

+++++
Process from Point/Station 1.091 to Point/Station 1.146

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

***** CONFLUENCE OF MAIN STREAMS *****

The following data inside Main Stream is listed:

In Main Stream number: 2

Stream flow area = 12.930(Ac.)

Runoff from this stream = 27.049(CFS)

Time of concentration = 9.12 min.

Rainfall intensity = 5.811(In/Hr)

Program is now starting with Main Stream No. 3

+++++
Process from Point/Station 1.111 to Point/Station 1.121

***** INITIAL AREA EVALUATION *****

Decimal fraction soil group A = 0.000

Decimal fraction soil group B = 0.000

Decimal fraction soil group C = 1.000

Decimal fraction soil group D = 0.000

[LOW DENSITY RESIDENTIAL]

(1.0 DU/A or Less)

Impervious value, Ai = 0.100

Sub-Area C Value = 0.360

Initial subarea total flow distance = 100.000(Ft.)

Highest elevation = 676.000(Ft.)

Lowest elevation = 674.000(Ft.)

Elevation difference = 2.000(Ft.) Slope = 2.000 %

INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:

The maximum overland flow distance is 85.00 (Ft)

for the top area slope value of 2.00 %, in a development type of 1.0 DU/A or Less

In Accordance With Figure 3-3

Initial Area Time of Concentration = 9.75 minutes

TC = [1.8*(1.1-C)*distance(Ft.)^.5]/(% slope^(1/3))

TC = [1.8*(1.1-0.3600)*(85.000^.5)/(2.000^(1/3))] = 9.75

The initial area total distance of 100.00 (Ft.) entered leaves a remaining distance of 15.00 (Ft.)

Using Figure 3-4, the travel time for this distance is 0.28 minutes

for a distance of 15.00 (Ft.) and a slope of 2.00 %

with an elevation difference of 0.30(Ft.) from the end of the top area

Tt = [11.9*length(Mi)^3]/(elevation change(Ft.))^.385 *60(min/hr) = 0.283 Minutes

Tt=[(11.9*0.0028^3)/(0.30)]^.385= 0.28

Total initial area Ti = 9.75 minutes from Figure 3-3 formula plus 0.28 minutes from the Figure 3-4 formula = 10.03 minutes

Rainfall intensity (I) = 5.465(In/Hr) for a 100.0 year storm

Effective runoff coefficient used for area (Q=KCIA) is C = 0.360

Subarea runoff = 0.689(CFS)

Total initial stream area = 0.350(Ac.)

+++++
Process from Point/Station 1.121 to Point/Station 1.145

***** IRREGULAR CHANNEL FLOW TRAVEL TIME *****

Estimated mean flow rate at midpoint of channel = 6.258(CFS)

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Depth of flow = 0.514(Ft.), Average velocity = 10.210(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
| 1 | 0.00 | 5.00 |
| 2 | 12.70 | 0.00 |
| 3 | 23.20 | 5.00 |

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 6.258(CFS)
' ' flow top width = 2.385(Ft.)
' ' velocity= 10.210(Ft/s)
' ' area = 0.613(Sq.Ft)
' ' Froude number = 3.549

Upstream point elevation = 674.000(Ft.)

Downstream point elevation = 582.000(Ft.)

Flow length = 710.000(Ft.)

Travel time = 1.16 min.

Time of concentration = 11.19 min.

Depth of flow = 0.514(Ft.)

Average velocity = 10.210(Ft/s)

Total irregular channel flow = 6.258(CFS)

Irregular channel normal depth above invert elev. = 0.514(Ft.)

Average velocity of channel(s) = 10.210(Ft/s)

Adding area flow to channel

Rainfall intensity (I) = 5.093(In/Hr) for a 100.0 year storm

Decimal fraction soil group A = 0.000

Decimal fraction soil group B = 0.000

Decimal fraction soil group C = 1.000

Decimal fraction soil group D = 0.000

[LOW DENSITY RESIDENTIAL]

(1.0 DU/A or Less)

Impervious value, Ai = 0.100

Sub-Area C Value = 0.360

Rainfall intensity = 5.093(In/Hr) for a 100.0 year storm

Effective runoff coefficient used for total area

(Q=KCIA) is C = 0.360 CA = 2.311

Subarea runoff = 11.082(CFS) for 6.070(Ac.)

Total runoff = 11.771(CFS) Total area = 6.420(Ac.)

Depth of flow = 0.651(Ft.), Average velocity = 11.957(Ft/s)

+++++
Process from Point/Station 1.111 to Point/Station 1.145

**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 3 in normal stream number 1

Stream flow area = 6.420(Ac.)

Runoff from this stream = 11.771(CFS)

Time of concentration = 11.19 min.

Rainfall intensity = 5.093(In/Hr)

+++++
+++++
+++++

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Process from Point/Station 1.131 to Point/Station 1.141
***** INITIAL AREA EVALUATION *****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL]
(1.0 DU/A or Less)
Impervious value, Ai = 0.100
Sub-Area C Value = 0.360
Initial subarea total flow distance = 100.000(Ft.)
Highest elevation = 642.000(Ft.)
Lowest elevation = 631.000(Ft.)
Elevation difference = 11.000(Ft.) Slope = 11.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 11.00 %, in a development type of
1.0 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration = 5.99 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.3600)*(100.000^.5)/(11.000^(1/3)]= 5.99
Rainfall intensity (I) = 7.622(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.360
Subarea runoff = 0.329(CFS)
Total initial stream area = 0.120(Ac.)

+++++
Process from Point/Station 1.141 to Point/Station 1.142
***** IMPROVED CHANNEL TRAVEL TIME *****

Upstream point elevation = 631.000(Ft.)
Downstream point elevation = 627.000(Ft.)
Channel length thru subarea = 50.000(Ft.)
Channel base width = 0.000(Ft.)
Slope or 'Z' of left channel bank = 3.000
Slope or 'Z' of right channel bank = 3.000
Estimated mean flow rate at midpoint of channel = 0.453(CFS)
Manning's 'N' = 0.025
Maximum depth of channel = 0.330(Ft.)
Flow(q) thru subarea = 0.453(CFS)
Depth of flow = 0.206(Ft.), Average velocity = 3.564(Ft/s)
Channel flow top width = 1.235(Ft.)
Flow Velocity = 3.56(Ft/s)
Travel time = 0.23 min.
Time of concentration = 6.22 min.
Critical depth = 0.270(Ft.)
Adding area flow to channel
Rainfall intensity (I) = 7.436(In/Hr) for a 100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL]

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

(1.0 DU/A or Less)
Impervious value, $A_i = 0.100$
Sub-Area C Value = 0.360
Rainfall intensity = 7.436(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for total area
($Q=KCIA$) is $C = 0.360$ $CA = 0.076$
Subarea runoff = 0.233(CFS) for 0.090(Ac.)
Total runoff = 0.562(CFS) Total area = 0.210(Ac.)
Depth of flow = 0.223(Ft.), Average velocity = 3.762(Ft/s)
Critical depth = 0.293(Ft.)

++++++
Process from Point/Station 1.142 to Point/Station 1.143
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 627.000(Ft.)
Downstream point elevation = 615.000(Ft.)
Channel length thru subarea = 60.000(Ft.)
Channel base width = 0.000(Ft.)
Slope or 'Z' of left channel bank = 3.000
Slope or 'Z' of right channel bank = 3.000
Manning's 'N' = 0.037
Maximum depth of channel = 1.000(Ft.)
Flow(q) thru subarea = 0.562(CFS)
Depth of flow = 0.218(Ft.), Average velocity = 3.953(Ft/s)
Channel flow top width = 1.306(Ft.)
Flow Velocity = 3.95(Ft/s)
Travel time = 0.25 min.
Time of concentration = 6.48 min.
Critical depth = 0.293(Ft.)

++++++
Process from Point/Station 1.143 to Point/Station 1.144
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 615.000(Ft.)
Downstream point elevation = 613.000(Ft.)
Channel length thru subarea = 10.000(Ft.)
Channel base width = 2.500(Ft.)
Slope or 'Z' of left channel bank = 3.000
Slope or 'Z' of right channel bank = 3.000
Manning's 'N' = 0.037
Maximum depth of channel = 0.830(Ft.)
Flow(q) thru subarea = 0.562(CFS)
Depth of flow = 0.071(Ft.), Average velocity = 2.915(Ft/s)
Channel flow top width = 2.926(Ft.)
Flow Velocity = 2.91(Ft/s)
Travel time = 0.06 min.
Time of concentration = 6.53 min.
Critical depth = 0.111(Ft.)

++++++
Process from Point/Station 1.144 to Point/Station 1.145

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

***** IRREGULAR CHANNEL FLOW TRAVEL TIME *****

Depth of flow = 0.077(Ft.), Average velocity = 3.406(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
| 1 | 0.00 | 1.00 |
| 2 | 29.30 | 0.00 |
| 3 | 56.40 | 1.00 |

Manning's 'N' friction factor = 0.020

| Sub-Channel flow | = | 0.562(CFS) |
|------------------|----------------|----------------|
| ' | flow top width | = 4.315(Ft.) |
| ' | velocity | = 3.406(Ft/s) |
| ' | area | = 0.165(Sq.Ft) |
| ' | Froude number | = 3.069 |

Upstream point elevation = 613.000(Ft.)

Downstream point elevation = 582.000(Ft.)

Flow length = 190.000(Ft.)

Travel time = 0.93 min.

Time of concentration = 7.46 min.

Depth of flow = 0.077(Ft.)

Average velocity = 3.406(Ft/s)

Total irregular channel flow = 0.562(CFS)

Irregular channel normal depth above invert elev. = 0.077(Ft.)

Average velocity of channel(s) = 3.406(Ft/s)

+++++
Process from Point/Station 1.131 to Point/Station 1.145

**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 3 in normal stream number 2

Stream flow area = 0.210(Ac.)

Runoff from this stream = 0.562(CFS)

Time of concentration = 7.46 min.

Rainfall intensity = 6.613(In/Hr)

Summary of stream data:

| Stream No. | Flow rate (CFS) | TC (min) | Rainfall Intensity (In/Hr) |
|------------|-----------------|----------|----------------------------|
|------------|-----------------|----------|----------------------------|

1 11.771 11.19 5.093

2 0.562 7.46 6.613

Qmax(1) =
1.000 * 1.000 * 11.771) +
0.770 * 1.000 * 0.562) + = 12.204

Qmax(2) =
1.000 * 0.667 * 11.771) +
1.000 * 1.000 * 0.562) + = 8.413

Total of 2 streams to confluence:

Flow rates before confluence point:

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

11.771 0.562
Maximum flow rates at confluence using above data:
12.204 8.413
Area of streams before confluence:
6.420 0.210
Results of confluence:
Total flow rate = 12.204(CFS)
Time of concentration = 11.189 min.
Effective stream area after confluence = 6.630(Ac.)

+++++
Process from Point/Station 1.145 to Point/Station 1.146
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

Depth of flow = 0.605(Ft.), Average velocity = 14.374(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
| 1 | 0.00 | 5.00 |
| 2 | 12.70 | 0.00 |
| 3 | 23.20 | 5.00 |

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 12.204(CFS)
' ' flow top width = 2.807(Ft.)
' ' velocity= 14.374(Ft/s)
' ' area = 0.849(Sq.Ft)
' ' Froude number = 4.606

Upstream point elevation = 582.000(Ft.)
Downstream point elevation = 551.000(Ft.)
Flow length = 150.000(Ft.)
Travel time = 0.17 min.
Time of concentration = 11.36 min.
Depth of flow = 0.605(Ft.)
Average velocity = 14.374(Ft/s)
Total irregular channel flow = 12.204(CFS)
Irregular channel normal depth above invert elev. = 0.605(Ft.)
Average velocity of channel(s) = 14.374(Ft/s)

+++++
Process from Point/Station 1.111 to Point/Station 1.146
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 3
Stream flow area = 6.630(Ac.)
Runoff from this stream = 12.204(CFS)
Time of concentration = 11.36 min.
Rainfall intensity = 5.043(In/Hr)
Summary of stream data:

| Stream | Flow rate | TC | Rainfall Intensity |
|--------|-----------|----|--------------------|
|--------|-----------|----|--------------------|

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

| No. | (CFS) | (min) | (In/Hr) |
|-----------|---------|---------|--------------------|
| 1 | 34.001 | 11.19 | 5.091 |
| 2 | 27.049 | 9.12 | 5.811 |
| 3 | 12.204 | 11.36 | 5.043 |
| Qmax(1) = | | | |
| | 1.000 * | 1.000 * | 34.001) + |
| | 0.876 * | 1.000 * | 27.049) + |
| | 1.000 * | 0.985 * | 12.204) + = 69.723 |
| Qmax(2) = | | | |
| | 1.000 * | 0.815 * | 34.001) + |
| | 1.000 * | 1.000 * | 27.049) + |
| | 1.000 * | 0.803 * | 12.204) + = 64.545 |
| Qmax(3) = | | | |
| | 0.990 * | 1.000 * | 34.001) + |
| | 0.868 * | 1.000 * | 27.049) + |
| | 1.000 * | 1.000 * | 12.204) + = 69.351 |

Total of 3 main streams to confluence:

Flow rates before confluence point:

34.001 27.049 12.204

Maximum flow rates at confluence using above data:

69.723 64.545 69.351

Area of streams before confluence:

18.550 12.930 6.630

Results of confluence:

Total flow rate = 69.723(CFS)

Time of concentration = 11.195 min.

Effective stream area after confluence = 38.110(Ac.)

+++++
Process from Point/Station 1.146 to Point/Station 1.182
***** IRREGULAR CHANNEL FLOW TRAVEL TIME *****

Depth of flow = 1.330(Ft.), Average velocity = 11.159(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
| 1 | 0.00 | 5.00 |
| 2 | 19.10 | 0.00 |
| 3 | 35.30 | 5.00 |

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 69.723(CFS)
' ' flow top width = 9.393(Ft.)
' ' velocity= 11.159(Ft/s)
' ' area = 6.248(Sq.Ft)
' ' Froude number = 2.411

Upstream point elevation = 551.000(Ft.)

Downstream point elevation = 542.000(Ft.)

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Flow length = 220.000(Ft.)
Travel time = 0.33 min.
Time of concentration = 11.52 min.
Depth of flow = 1.330(Ft.)
Average velocity = 11.159(Ft/s)
Total irregular channel flow = 69.723(CFS)
Irregular channel normal depth above invert elev. = 1.330(Ft.)
Average velocity of channel(s) = 11.159(Ft/s)

++++++
Process from Point/Station 1.011 to Point/Station 1.182
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 38.110(Ac.)
Runoff from this stream = 69.723(CFS)
Time of concentration = 11.52 min.
Rainfall intensity = 4.997(In/Hr)

++++++
Process from Point/Station 1.151 to Point/Station 1.161
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL]
(1.0 DU/A or Less)
Impervious value, Ai = 0.100
Sub-Area C Value = 0.360
Initial subarea total flow distance = 100.000(Ft.)
Highest elevation = 642.500(Ft.)
Lowest elevation = 640.000(Ft.)
Elevation difference = 2.500(Ft.) Slope = 2.500 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 2.50 %, in a development type of
1.0 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration = 9.81 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^0.5]/(% slope^(1/3))
TC = [1.8*(1.1-0.3600)*(100.000^0.5)]/(2.500^(1/3))= 9.81
Rainfall intensity (I) = 5.543(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.360
Subarea runoff = 0.080(CFS)
Total initial stream area = 0.040(Ac.)

++++++
Process from Point/Station 1.161 to Point/Station 1.182
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

Estimated mean flow rate at midpoint of channel = 1.391(CFS)

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Depth of flow = 0.178(Ft.), Average velocity = 6.647(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
| 1 | 0.00 | 5.00 |
| 2 | 39.30 | 0.00 |
| 3 | 65.80 | 5.00 |

Manning's 'N' friction factor = 0.020

| Sub-Channel flow | = | 1.391(CFS) |
|------------------|---|-----------------------------|
| ' | ' | flow top width = 2.347(Ft.) |
| ' | ' | velocity= 6.647(Ft/s) |
| ' | ' | area = 0.209(Sq.Ft) |
| ' | ' | Froude number = 3.923 |

Upstream point elevation = 640.000(Ft.)

Downstream point elevation = 542.000(Ft.)

Flow length = 480.000(Ft.)

Travel time = 1.20 min.

Time of concentration = 11.02 min.

Depth of flow = 0.178(Ft.)

Average velocity = 6.647(Ft/s)

Total irregular channel flow = 1.391(CFS)

Irregular channel normal depth above invert elev. = 0.178(Ft.)

Average velocity of channel(s) = 6.647(Ft/s)

Adding area flow to channel

Rainfall intensity (I) = 5.144(In/Hr) for a 100.0 year storm

Decimal fraction soil group A = 0.000

Decimal fraction soil group B = 0.000

Decimal fraction soil group C = 1.000

Decimal fraction soil group D = 0.000

[UNDISTURBED NATURAL TERRAIN

]

(Permanent Open Space)

Impervious value, Ai = 0.000

Sub-Area C Value = 0.300

Rainfall intensity = 5.144(In/Hr) for a 100.0 year storm

Effective runoff coefficient used for total area

(Q=KCIA) is C = 0.301 CA = 0.506

Subarea runoff = 2.525(CFS) for 1.640(Ac.)

Total runoff = 2.605(CFS) Total area = 1.680(Ac.)

Depth of flow = 0.226(Ft.), Average velocity = 7.777(Ft/s)

+++++
Process from Point/Station 1.151 to Point/Station 1.182

**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2

Stream flow area = 1.680(Ac.)

Runoff from this stream = 2.605(CFS)

Time of concentration = 11.02 min.

Rainfall intensity = 5.144(In/Hr)

+++++
+++++
+++++

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Process from Point/Station 1.171 to Point/Station 1.181
***** INITIAL AREA EVALUATION *****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL]
(1.0 DU/A or Less)
Impervious value, Ai = 0.100
Sub-Area C Value = 0.360
Initial subarea total flow distance = 100.000(Ft.)
Highest elevation = 714.000(Ft.)
Lowest elevation = 695.000(Ft.)
Elevation difference = 19.000(Ft.) Slope = 19.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 19.00 %, in a development type of
1.0 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration = 4.99 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.3600)*(100.000^.5)/(19.000^(1/3)] = 4.99
Calculated TC of 4.992 minutes is less than 5 minutes,
resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) = 8.563(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.360
Subarea runoff = 2.620(CFS)
Total initial stream area = 0.850(Ac.)

+++++
Process from Point/Station 1.181 to Point/Station 1.182
***** IRREGULAR CHANNEL FLOW TRAVEL TIME *****

Estimated mean flow rate at midpoint of channel = 19.367(CFS)
Depth of flow = 0.774(Ft.), Average velocity = 11.184(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :
Point number 'X' coordinate 'Y' coordinate
1 0.00 5.00
2 17.80 0.00
3 28.90 5.00
Manning's 'N' friction factor = 0.020

Sub-Channel flow = 19.367(CFS)
' flow top width = 4.474(Ft.)
' velocity= 11.184(Ft/s)
' area = 1.732(Sq.Ft)
' Froude number = 3.168

Upstream point elevation = 695.000(Ft.)
Downstream point elevation = 542.000(Ft.)
Flow length = 1760.000(Ft.)
Travel time = 2.62 min.

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Time of concentration = 7.61 min.
Depth of flow = 0.774(Ft.)
Average velocity = 11.184(Ft/s)
Total irregular channel flow = 19.367(CFS)
Irregular channel normal depth above invert elev. = 0.774(Ft.)
Average velocity of channel(s) = 11.184(Ft/s)
Adding area flow to channel
Rainfall intensity (I) = 6.528(In/Hr) for a 100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[UNDISTURBED NATURAL TERRAIN]
(Permanent Open Space)
Impervious value, Ai = 0.000
Sub-Area C Value = 0.300
Rainfall intensity = 6.528(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.303 CA = 5.523
Subarea runoff = 33.435(CFS) for 17.390(Ac.)
Total runoff = 36.055(CFS) Total area = 18.240(Ac.)
Depth of flow = 0.977(Ft.), Average velocity = 13.064(Ft/s)

+++++
Process from Point/Station 1.171 to Point/Station 1.182
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 3

Stream flow area = 18.240(Ac.)
Runoff from this stream = 36.055(CFS)
Time of concentration = 7.61 min.
Rainfall intensity = 6.528(In/Hr)
Summary of stream data:

| Stream No. | Flow rate (CFS) | TC (min) | Rainfall Intensity (In/Hr) |
|------------|-----------------|----------|----------------------------|
| 1 | 69.723 | 11.52 | 4.997 |
| 2 | 2.605 | 11.02 | 5.144 |
| 3 | 36.055 | 7.61 | 6.528 |

Qmax(1) =
1.000 * 1.000 * 69.723) +
0.971 * 1.000 * 2.605) +
0.765 * 1.000 * 36.055) + = 99.854

Qmax(2) =
1.000 * 0.956 * 69.723) +
1.000 * 1.000 * 2.605) +
0.788 * 1.000 * 36.055) + = 97.680

Qmax(3) =
1.000 * 0.661 * 69.723) +
1.000 * 0.691 * 2.605) +
1.000 * 1.000 * 36.055) + = 83.928

Total of 3 streams to confluence:

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Flow rates before confluence point:
69.723 2.605 36.055
Maximum flow rates at confluence using above data:
99.854 97.680 83.928
Area of streams before confluence:
38.110 1.680 18.240
Results of confluence:
Total flow rate = 99.854(CFS)
Time of concentration = 11.523 min.
Effective stream area after confluence = 58.030(Ac.)

+++++
Process from Point/Station 1.182 to Point/Station 1.232
***** IRREGULAR CHANNEL FLOW TRAVEL TIME *****

Depth of flow = 1.741(Ft.), Average velocity = 9.334(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
| 1 | 0.00 | 5.00 |
| 2 | 19.10 | 0.00 |
| 3 | 35.30 | 5.00 |

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 99.854(CFS)
' flow top width = 12.290(Ft.)
' velocity= 9.334(Ft/s)
' area = 10.698(Sq.Ft)
' Froude number = 1.763

Upstream point elevation = 542.000(Ft.)

Downstream point elevation = 537.000(Ft.)

Flow length = 250.000(Ft.)

Travel time = 0.45 min.

Time of concentration = 11.97 min.

Depth of flow = 1.741(Ft.)

Average velocity = 9.334(Ft/s)

Total irregular channel flow = 99.854(CFS)

Irregular channel normal depth above invert elev. = 1.741(Ft.)

Average velocity of channel(s) = 9.334(Ft/s)

+++++
Process from Point/Station 1.011 to Point/Station 1.232
***** CONFLUENCE OF MINOR STREAMS *****

Along Main Stream number: 1 in normal stream number 1

Stream flow area = 58.030(Ac.)

Runoff from this stream = 99.854(CFS)

Time of concentration = 11.97 min.

Rainfall intensity = 4.876(In/Hr)

+++++

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Process from Point/Station 1.191 to Point/Station 1.201
***** INITIAL AREA EVALUATION *****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL]
(1.0 DU/A or Less)
Impervious value, Ai = 0.100
Sub-Area C Value = 0.360
Initial subarea total flow distance = 100.000(Ft.)
Highest elevation = 643.000(Ft.)
Lowest elevation = 638.400(Ft.)
Elevation difference = 4.600(Ft.) Slope = 4.600 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 4.60 %, in a development type of
1.0 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration = 8.01 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^0.5]/(% slope^(1/3))
TC = [1.8*(1.1-0.3600)*(100.000^0.5)/(4.600^(1/3))] = 8.01
Rainfall intensity (I) = 6.319(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.360
Subarea runoff = 0.114(CFS)
Total initial stream area = 0.050(Ac.)

+++++
Process from Point/Station 1.201 to Point/Station 1.202
***** IMPROVED CHANNEL TRAVEL TIME *****

Upstream point elevation = 638.400(Ft.)
Downstream point elevation = 617.000(Ft.)
Channel length thru subarea = 350.000(Ft.)
Channel base width = 0.000(Ft.)
Slope or 'Z' of left channel bank = 3.000
Slope or 'Z' of right channel bank = 3.000
Estimated mean flow rate at midpoint of channel = 0.495(CFS)
Manning's 'N' = 0.025
Maximum depth of channel = 0.330(Ft.)
Flow(q) thru subarea = 0.495(CFS)
Depth of flow = 0.224(Ft.), Average velocity = 3.296(Ft/s)
Channel flow top width = 1.343(Ft.)
Flow Velocity = 3.30(Ft/s)
Travel time = 1.77 min.
Time of concentration = 9.78 min.
Critical depth = 0.279(Ft.)
Adding area flow to channel
Rainfall intensity (I) = 5.555(In/Hr) for a 100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL]

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

(1.0 DU/A or Less)
Impervious value, $A_i = 0.100$
Sub-Area C Value = 0.360
Rainfall intensity = 5.555(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for total area
($Q=KCIA$) is $C = 0.360$ $CA = 0.148$
Subarea runoff = 0.706(CFS) for 0.360(Ac.)
Total runoff = 0.820(CFS) Total area = 0.410(Ac.)
Depth of flow = 0.270(Ft.), Average velocity = 3.738(Ft/s)
Critical depth = 0.340(Ft.)

++++++
Process from Point/Station 1.202 to Point/Station 1.203
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 617.000(Ft.)
Downstream point elevation = 616.900(Ft.)
Channel length thru subarea = 10.000(Ft.)
Channel base width = 2.500(Ft.)
Slope or 'Z' of left channel bank = 3.000
Slope or 'Z' of right channel bank = 3.000
Manning's 'N' = 0.037
Maximum depth of channel = 0.830(Ft.)
Flow(q) thru subarea = 0.820(CFS)
Depth of flow = 0.211(Ft.), Average velocity = 1.243(Ft/s)
Channel flow top width = 3.764(Ft.)
Flow Velocity = 1.24(Ft/s)
Travel time = 0.13 min.
Time of concentration = 9.91 min.
Critical depth = 0.141(Ft.)

++++++
Process from Point/Station 1.203 to Point/Station 1.204
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 616.900(Ft.)
Downstream point elevation = 616.000(Ft.)
Channel length thru subarea = 100.000(Ft.)
Channel base width = 0.000(Ft.)
Slope or 'Z' of left channel bank = 3.000
Slope or 'Z' of right channel bank = 3.000
Manning's 'N' = 0.025
Maximum depth of channel = 0.500(Ft.)
Flow(q) thru subarea = 0.820(CFS)
Depth of flow = 0.387(Ft.), Average velocity = 1.822(Ft/s)
Channel flow top width = 2.324(Ft.)
Flow Velocity = 1.82(Ft/s)
Travel time = 0.91 min.
Time of concentration = 10.83 min.
Critical depth = 0.342(Ft.)

++++++
Process from Point/Station 1.204 to Point/Station 1.205

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

***** IMPROVED CHANNEL TRAVEL TIME *****

Upstream point elevation = 616.000(Ft.)
Downstream point elevation = 615.000(Ft.)
Channel length thru subarea = 10.000(Ft.)
Channel base width = 2.500(Ft.)
Slope or 'Z' of left channel bank = 3.000
Slope or 'Z' of right channel bank = 3.000
Manning's 'N' = 0.037
Maximum depth of channel = 0.830(Ft.)
Flow(q) thru subarea = 0.820(CFS)
Depth of flow = 0.109(Ft.), Average velocity = 2.670(Ft/s)
Channel flow top width = 3.152(Ft.)
Flow Velocity = 2.67(Ft/s)
Travel time = 0.06 min.
Time of concentration = 10.89 min.
Critical depth = 0.141(Ft.)

+++++
Process from Point/Station 1.205 to Point/Station 1.232
***** IRREGULAR CHANNEL FLOW TRAVEL TIME *****

Estimated mean flow rate at midpoint of channel = 1.636(CFS)
Depth of flow = 0.080(Ft.), Average velocity = 5.046(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :
Point number 'X' coordinate 'Y' coordinate
1 0.00 1.54
2 6.50 0.58
3 52.50 0.40
4 85.90 0.00
5 114.60 1.54

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 1.636(CFS)
' flow top width = 8.139(Ft.)
' velocity= 5.046(Ft/s)
' area = 0.324(Sq.Ft)
' Froude number = 4.455

Upstream point elevation = 615.000(Ft.)
Downstream point elevation = 537.000(Ft.)
Flow length = 230.000(Ft.)
Travel time = 0.76 min.
Time of concentration = 11.65 min.
Depth of flow = 0.080(Ft.)
Average velocity = 5.046(Ft/s)
Total irregular channel flow = 1.636(CFS)
Irregular channel normal depth above invert elev. = 0.080(Ft.)
Average velocity of channel(s) = 5.046(Ft/s)
Adding area flow to channel
Rainfall intensity (I) = 4.962(In/Hr) for a 100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[UNDISTURBED NATURAL TERRAIN]
(Permanent Open Space)
Impervious value, Ai = 0.000
Sub-Area C Value = 0.300
Rainfall intensity = 4.962(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.316 CA = 0.478
Subarea runoff = 1.550(CFS) for 1.100(Ac.)
Total runoff = 2.370(CFS) Total area = 1.510(Ac.)
Depth of flow = 0.092(Ft.), Average velocity = 5.536(Ft/s)

+++++
Process from Point/Station 1.191 to Point/Station 1.232
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 1.510(Ac.)
Runoff from this stream = 2.370(CFS)
Time of concentration = 11.65 min.
Rainfall intensity = 4.962(In/Hr)

+++++
Process from Point/Station 1.221 to Point/Station 1.231
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL]
(1.0 DU/A or Less)
Impervious value, Ai = 0.100
Sub-Area C Value = 0.360
Initial subarea total flow distance = 100.000(Ft.)
Highest elevation = 634.000(Ft.)
Lowest elevation = 625.000(Ft.)
Elevation difference = 9.000(Ft.) Slope = 9.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 9.00 %, in a development type of
1.0 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration = 6.40 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^0.5]/(% slope^(1/3))
TC = [1.8*(1.1-0.3600)*(100.000^0.5)/(9.000^(1/3))] = 6.40
Rainfall intensity (I) = 7.300(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.360
Subarea runoff = 0.526(CFS)
Total initial stream area = 0.200(Ac.)

+++++

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Process from Point/Station 1.231 to Point/Station 1.232
***** IRREGULAR CHANNEL FLOW TRAVEL TIME *****

Estimated mean flow rate at midpoint of channel = 5.899(CFS)

Depth of flow = 0.372(Ft.), Average velocity = 7.431(Ft/s)

***** Irregular Channel Data *****

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
| 1 | 0.00 | 5.00 |
| 2 | 32.00 | 0.00 |
| 3 | 57.40 | 5.00 |

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 5.899(CFS)

flow top width = 4.269(Ft.)

velocity= 7.431(Ft/s)

area = 0.794(Sq.Ft)

Froude number = 3.037

Upstream point elevation = 625.000(Ft.)

Downstream point elevation = 537.000(Ft.)

Flow length = 915.000(Ft.)

Travel time = 2.05 min.

Time of concentration = 8.46 min.

Depth of flow = 0.372(Ft.)

Average velocity = 7.431(Ft/s)

Total irregular channel flow = 5.899(CFS)

Irregular channel normal depth above invert elev. = 0.372(Ft.)

Average velocity of channel(s) = 7.431(Ft/s)

Adding area flow to channel

Rainfall intensity (I) = 6.102(In/Hr) for a 100.0 year storm

Decimal fraction soil group A = 0.000

Decimal fraction soil group B = 0.000

Decimal fraction soil group C = 1.000

Decimal fraction soil group D = 0.000

[UNDISTURBED NATURAL TERRAIN

]

(Permanent Open Space)

Impervious value, Ai = 0.000

Sub-Area C Value = 0.300

Rainfall intensity = 6.102(In/Hr) for a 100.0 year storm

Effective runoff coefficient used for total area

(Q=KCIA) is C = 0.302 CA = 1.833

Subarea runoff = 10.659(CFS) for 5.870(Ac.)

Total runoff = 11.184(CFS) Total area = 6.070(Ac.)

Depth of flow = 0.473(Ft.), Average velocity = 8.720(Ft/s)

+++++
+++++
+++++
+++++

Process from Point/Station 1.221 to Point/Station 1.232

***** CONFLUENCE OF MINOR STREAMS *****

Along Main Stream number: 1 in normal stream number 3

Stream flow area = 6.070(Ac.)

Runoff from this stream = 11.184(CFS)

Time of concentration = 8.46 min.

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Rainfall intensity = 6.102 (In/Hr)
Summary of stream data:

| Stream No. | Flow rate (CFS) | TC (min) | Rainfall Intensity (In/Hr) |
|------------|-------------------------|-------------------------|--|
| 1 | 99.854 | 11.97 | 4.876 |
| 2 | 2.370 | 11.65 | 4.962 |
| 3 | 11.184 | 8.46 | 6.102 |
| Qmax(1) = | 1.000 * 0.983 * 0.799 * | 1.000 * 1.000 * 1.000 * | 99.854) + 2.370) + 11.184) + = 111.121 |
| Qmax(2) = | 1.000 * 1.000 * 0.813 * | 0.973 * 1.000 * 1.000 * | 99.854) + 2.370) + 11.184) + = 108.652 |
| Qmax(3) = | 1.000 * 1.000 * 1.000 * | 0.706 * 0.726 * 1.000 * | 99.854) + 2.370) + 11.184) + = 83.444 |

Total of 3 streams to confluence:

Flow rates before confluence point:
99.854 2.370 11.184

Maximum flow rates at confluence using above data:

111.121 108.652 83.444

Area of streams before confluence:

58.030 1.510 6.070

Results of confluence:

Total flow rate = 111.121 (CFS)

Time of concentration = 11.970 min.

Effective stream area after confluence = 65.610 (Ac.)

+++++
Process from Point/Station 1.232 to Point/Station 1.272
***** IRREGULAR CHANNEL FLOW TRAVEL TIME *****

Depth of flow = 1.812 (Ft.), Average velocity = 9.587 (Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
| 1 | 0.00 | 5.00 |
| 2 | 19.10 | 0.00 |
| 3 | 35.30 | 5.00 |

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 111.122 (CFS)
' ' flow top width = 12.793 (Ft.)
' ' velocity = 9.587 (Ft/s)
' ' area = 11.591 (Sq.Ft)
' ' Froude number = 1.775

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Upstream point elevation = 537.000(Ft.)
Downstream point elevation = 534.000(Ft.)
Flow length = 150.000(Ft.)
Travel time = 0.26 min.
Time of concentration = 12.23 min.
Depth of flow = 1.812(Ft.)
Average velocity = 9.587(Ft/s)
Total irregular channel flow = 111.121(CFS)
Irregular channel normal depth above invert elev. = 1.812(Ft.)
Average velocity of channel(s) = 9.587(Ft/s)

++++++
Process from Point/Station 1.011 to Point/Station 1.272
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 65.610(Ac.)
Runoff from this stream = 111.121(CFS)
Time of concentration = 12.23 min.
Rainfall intensity = 4.809(In/Hr)

++++++
Process from Point/Station 1.241 to Point/Station 1.251
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[UNDISTURBED NATURAL TERRAIN]
(Permanent Open Space)
Impervious value, Ai = 0.000
Sub-Area C Value = 0.300
Initial subarea total flow distance = 100.000(Ft.)
Highest elevation = 616.800(Ft.)
Lowest elevation = 596.300(Ft.)
Elevation difference = 20.500(Ft.) Slope = 20.500 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 20.50 %, in a development type of
Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration = 5.26 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^0.5]/(% slope^(1/3))
TC = [1.8*(1.1-0.300)*(100.000^0.5)/(20.500^(1/3))] = 5.26
Rainfall intensity (I) = 8.286(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.300
Subarea runoff = 0.572(CFS)
Total initial stream area = 0.230(Ac.)

++++++
Process from Point/Station 1.251 to Point/Station 1.272
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Estimated mean flow rate at midpoint of channel = 1.330(CFS)
Depth of flow = 0.172(Ft.), Average velocity = 9.103(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
| 1 | 0.00 | 5.00 |
| 2 | 29.40 | 0.00 |
| 3 | 49.60 | 5.00 |

Manning's 'N' friction factor = 0.020

| Sub-Channel flow | = | 1.330(CFS) |
|------------------|----------------|----------------|
| ' | flow top width | = 1.702(Ft.) |
| ' | velocity | = 9.103(Ft/s) |
| ' | area | = 0.146(Sq.Ft) |
| ' | Froude number | = 5.476 |

Upstream point elevation = 596.300(Ft.)

Downstream point elevation = 527.000(Ft.)

Flow length = 170.000(Ft.)

Travel time = 0.31 min.

Time of concentration = 5.57 min.

Depth of flow = 0.172(Ft.)

Average velocity = 9.103(Ft/s)

Total irregular channel flow = 1.330(CFS)

Irregular channel normal depth above invert elev. = 0.172(Ft.)

Average velocity of channel(s) = 9.103(Ft/s)

Adding area flow to channel

Rainfall intensity (I) = 7.984(In/Hr) for a 100.0 year storm

Decimal fraction soil group A = 0.000

Decimal fraction soil group B = 0.000

Decimal fraction soil group C = 1.000

Decimal fraction soil group D = 0.000

[UNDISTURBED NATURAL TERRAIN

]

(Permanent Open Space)

Impervious value, Ai = 0.000

Sub-Area C Value = 0.300

Rainfall intensity = 7.984(In/Hr) for a 100.0 year storm

Effective runoff coefficient used for total area

(Q=KCIA) is C = 0.300 CA = 0.252

Subarea runoff = 1.440(CFS) for 0.610(Ac.)

Total runoff = 2.012(CFS) Total area = 0.840(Ac.)

Depth of flow = 0.200(Ft.), Average velocity = 10.096(Ft/s)

+++++
Process from Point/Station 1.241 to Point/Station 1.272

**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2

Stream flow area = 0.840(Ac.)

Runoff from this stream = 2.012(CFS)

Time of concentration = 5.57 min.

Rainfall intensity = 7.984(In/Hr)

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

+++++
Process from Point/Station 1.261 to Point/Station 1.271
***** INITIAL AREA EVALUATION *****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[UNDISTURBED NATURAL TERRAIN]
(Permanent Open Space)
Impervious value, Ai = 0.000
Sub-Area C Value = 0.300
Initial subarea total flow distance = 100.000(Ft.)
Highest elevation = 639.000(Ft.)
Lowest elevation = 635.000(Ft.)
Elevation difference = 4.000(Ft.) Slope = 4.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 4.00 %, in a development type of
Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration = 9.07 minutes
 $TC = [1.8 * (1.1 - C) * distance(Ft.)^{0.5} / (% slope^{1/3})]$
 $TC = [1.8 * (1.1 - 0.300) * (100.000^{0.5}) / (4.000^{1/3})] = 9.07$
Rainfall intensity (I) = 5.831(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.300
Subarea runoff = 0.245(CFS)
Total initial stream area = 0.140(Ac.)

+++++
Process from Point/Station 1.271 to Point/Station 1.272
***** IRREGULAR CHANNEL FLOW TRAVEL TIME *****

Estimated mean flow rate at midpoint of channel = 5.843(CFS)
Depth of flow = 0.460(Ft.), Average velocity = 9.202(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :
Point number 'X' coordinate 'Y' coordinate
1 0.00 5.00
2 15.10 0.00
3 30.00 5.00
Manning's 'N' friction factor = 0.020

Sub-Channel flow = 5.843(CFS)
' flow top width = 2.760(Ft.)
' velocity= 9.202(Ft/s)
' area = 0.635(Sq.Ft)
' Froude number = 3.381

Upstream point elevation = 635.000(Ft.)
Downstream point elevation = 527.000(Ft.)
Flow length = 925.000(Ft.)
Travel time = 1.68 min.

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Time of concentration = 10.75 min.
Depth of flow = 0.460(Ft.)
Average velocity = 9.202(Ft/s)
Total irregular channel flow = 5.843(CFS)
Irregular channel normal depth above invert elev. = 0.460(Ft.)
Average velocity of channel(s) = 9.202(Ft/s)
Adding area flow to channel
Rainfall intensity (I) = 5.227(In/Hr) for a 100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[UNDISTURBED NATURAL TERRAIN]
(Permanent Open Space)
Impervious value, Ai = 0.000
Sub-Area C Value = 0.300
Rainfall intensity = 5.227(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.300 CA = 2.172
Subarea runoff = 11.109(CFS) for 7.100(Ac.)
Total runoff = 11.354(CFS) Total area = 7.240(Ac.)
Depth of flow = 0.590(Ft.), Average velocity = 10.865(Ft/s)

+++++
Process from Point/Station 1.261 to Point/Station 1.272
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 3

Stream flow area = 7.240(Ac.)
Runoff from this stream = 11.354(CFS)
Time of concentration = 10.75 min.
Rainfall intensity = 5.227(In/Hr)
Summary of stream data:

| Stream No. | Flow rate (CFS) | TC (min) | Rainfall Intensity (In/Hr) |
|------------|-----------------|----------|----------------------------|
| 1 | 111.121 | 12.23 | 4.809 |
| 2 | 2.012 | 5.57 | 7.984 |
| 3 | 11.354 | 10.75 | 5.227 |

Qmax(1) =
1.000 * 1.000 * 111.121) +
0.602 * 1.000 * 2.012) +
0.920 * 1.000 * 11.354) + = 122.778

Qmax(2) =
1.000 * 0.456 * 111.121) +
1.000 * 1.000 * 2.012) +
1.000 * 0.519 * 11.354) + = 58.532

Qmax(3) =
1.000 * 0.879 * 111.121) +
0.655 * 1.000 * 2.012) +
1.000 * 1.000 * 11.354) + = 110.311

Total of 3 streams to confluence:

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Flow rates before confluence point:
111.121 2.012 11.354
Maximum flow rates at confluence using above data:
122.778 58.532 110.311
Area of streams before confluence:
65.610 0.840 7.240
Results of confluence:
Total flow rate = 122.778(CFS)
Time of concentration = 12.231 min.
Effective stream area after confluence = 73.690(Ac.)

+++++
Process from Point/Station 1.272 to Point/Station 1.333
***** IRREGULAR CHANNEL FLOW TRAVEL TIME *****

Estimated mean flow rate at midpoint of channel = 122.821(CFS)
Depth of flow = 1.906(Ft.), Average velocity = 15.301(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :
Point number 'X' coordinate 'Y' coordinate
1 0.00 5.00
2 9.70 0.00
3 22.10 5.00
Manning's 'N' friction factor = 0.020

Sub-Channel flow = 122.821(CFS)
' flow top width = 8.424(Ft.)
' velocity= 15.301(Ft/s)
' area = 8.027(Sq.Ft)
' Froude number = 2.762

Upstream point elevation = 527.000(Ft.)
Downstream point elevation = 507.000(Ft.)
Flow length = 390.000(Ft.)
Travel time = 0.42 min.
Time of concentration = 12.66 min.
Depth of flow = 1.906(Ft.)
Average velocity = 15.301(Ft/s)
Total irregular channel flow = 122.821(CFS)
Irregular channel normal depth above invert elev. = 1.906(Ft.)
Average velocity of channel(s) = 15.301(Ft/s)

Adding area flow to channel
Rainfall intensity (I) = 4.704(In/Hr) for a 100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[UNDISTURBED NATURAL TERRAIN]
(Permanent Open Space)
Impervious value, Ai = 0.000
Sub-Area C Value = 0.300
The area added to the existing stream causes a
a lower flow rate of Q = 119.735(CFS)
therefore the upstream flow rate of Q = 122.778(CFS) is being used

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Rainfall intensity = 4.704(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.331 CA = 25.453
Subarea runoff = 0.000(CFS) for 3.230(Ac.)
Total runoff = 122.778(CFS) Total area = 76.920(Ac.)
Depth of flow = 1.906(Ft.), Average velocity = 15.300(Ft/s)

++++++
Process from Point/Station 1.011 to Point/Station 1.333
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area = 76.920(Ac.)
Runoff from this stream = 122.778(CFS)
Time of concentration = 12.66 min.
Rainfall intensity = 4.704(In/Hr)
Program is now starting with Main Stream No. 2

++++++
Process from Point/Station 1.291 to Point/Station 1.301
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[UNDISTURBED NATURAL TERRAIN]
(Permanent Open Space)
Impervious value, Ai = 0.000
Sub-Area C Value = 0.300
Initial subarea total flow distance = 100.000(Ft.)
Highest elevation = 667.000(Ft.)
Lowest elevation = 662.000(Ft.)
Elevation difference = 5.000(Ft.) Slope = 5.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 5.00 %, in a development type of
Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration = 8.42 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^0.5]/(% slope^(1/3))
TC = [1.8*(1.1-0.300)*(100.000^0.5)/(5.000^(1/3))] = 8.42
Rainfall intensity (I) = 6.118(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.300
Subarea runoff = 0.147(CFS)
Total initial stream area = 0.080(Ac.)

++++++
Process from Point/Station 1.301 to Point/Station 1.331
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

Estimated mean flow rate at midpoint of channel = 3.707(CFS)

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Depth of flow = 0.409(Ft.), Average velocity = 9.628(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
| 1 | 0.00 | 5.00 |
| 2 | 11.40 | 0.00 |
| 3 | 23.00 | 5.00 |

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 3.707(CFS)
' ' flow top width = 1.882(Ft.)
' ' velocity= 9.628(Ft/s)
' ' area = 0.385(Sq.Ft)
' ' Froude number = 3.751

Upstream point elevation = 662.000(Ft.)

Downstream point elevation = 555.700(Ft.)

Flow length = 680.000(Ft.)

Travel time = 1.18 min.

Time of concentration = 9.60 min.

Depth of flow = 0.409(Ft.)

Average velocity = 9.628(Ft/s)

Total irregular channel flow = 3.707(CFS)

Irregular channel normal depth above invert elev. = 0.409(Ft.)

Average velocity of channel(s) = 9.628(Ft/s)

Adding area flow to channel

Rainfall intensity (I) = 5.623(In/Hr) for a 100.0 year storm

Decimal fraction soil group A = 0.000

Decimal fraction soil group B = 0.000

Decimal fraction soil group C = 1.000

Decimal fraction soil group D = 0.000

[UNDISTURBED NATURAL TERRAIN]

(Permanent Open Space)

Impervious value, Ai = 0.000

Sub-Area C Value = 0.300

Rainfall intensity = 5.623(In/Hr) for a 100.0 year storm

Effective runoff coefficient used for total area

(Q=KCIA) is C = 0.300 CA = 1.278

Subarea runoff = 7.039(CFS) for 4.180(Ac.)

Total runoff = 7.186(CFS) Total area = 4.260(Ac.)

Depth of flow = 0.524(Ft.), Average velocity = 11.360(Ft/s)

+++++
Process from Point/Station 1.291 to Point/Station 1.331
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 2 in normal stream number 1

Stream flow area = 4.260(Ac.)

Runoff from this stream = 7.186(CFS)

Time of concentration = 9.60 min.

Rainfall intensity = 5.623(In/Hr)

+++++

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Process from Point/Station 1.311 to Point/Station 1.321
***** INITIAL AREA EVALUATION *****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL]
(1.0 DU/A or Less)
Impervious value, Ai = 0.100
Sub-Area C Value = 0.360
Initial subarea total flow distance = 100.000(Ft.)
Highest elevation = 642.500(Ft.)
Lowest elevation = 631.800(Ft.)
Elevation difference = 10.700(Ft.) Slope = 10.700 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 10.70 %, in a development type of
1.0 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration = 6.04 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.3600)*(100.000^.5)/(10.700^(1/3)]= 6.04
Rainfall intensity (I) = 7.576(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.360
Subarea runoff = 0.245(CFS)
Total initial stream area = 0.090(Ac.)

+++++
Process from Point/Station 1.321 to Point/Station 1.322
***** IMPROVED CHANNEL TRAVEL TIME *****

Upstream point elevation = 631.800(Ft.)
Downstream point elevation = 618.800(Ft.)
Channel length thru subarea = 275.000(Ft.)
Channel base width = 0.000(Ft.)
Slope or 'Z' of left channel bank = 3.000
Slope or 'Z' of right channel bank = 3.000
Estimated mean flow rate at midpoint of channel = 0.835(CFS)
Manning's 'N' = 0.037
Maximum depth of channel = 1.000(Ft.)
Flow(q) thru subarea = 0.835(CFS)
Depth of flow = 0.331(Ft.), Average velocity = 2.541(Ft/s)
Channel flow top width = 1.986(Ft.)
Flow Velocity = 2.54(Ft/s)
Travel time = 1.80 min.
Time of concentration = 7.85 min.
Critical depth = 0.344(Ft.)
Adding area flow to channel
Rainfall intensity (I) = 6.402(In/Hr) for a 100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL]

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

(1.0 DU/A or Less)
Impervious value, $A_i = 0.100$
Sub-Area C Value = 0.360
Rainfall intensity = 6.402(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for total area
($Q=KCIA$) is $C = 0.360$ $CA = 0.212$
Subarea runoff = 1.114(CFS) for 0.500(Ac.)
Total runoff = 1.360(CFS) Total area = 0.590(Ac.)
Depth of flow = 0.397(Ft.), Average velocity = 2.871(Ft/s)
Critical depth = 0.418(Ft.)

+++++
Process from Point/Station 1.322 to Point/Station 1.323
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 618.800(Ft.)
Downstream point elevation = 614.500(Ft.)
Channel length thru subarea = 10.000(Ft.)
Channel base width = 2.500(Ft.)
Slope or 'Z' of left channel bank = 3.000
Slope or 'Z' of right channel bank = 3.000
Manning's 'N' = 0.037
Maximum depth of channel = 0.830(Ft.)
Flow(q) thru subarea = 1.360(CFS)
Depth of flow = 0.095(Ft.), Average velocity = 5.117(Ft/s)
Channel flow top width = 3.072(Ft.)
Flow Velocity = 5.12(Ft/s)
Travel time = 0.03 min.
Time of concentration = 7.88 min.
Critical depth = 0.193(Ft.)

+++++
Process from Point/Station 1.323 to Point/Station 1.331
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

Depth of flow = 0.112(Ft.), Average velocity = 5.549(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :
Point number 'X' coordinate 'Y' coordinate
1 0.00 1.00
2 15.10 0.00
3 39.20 1.00

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 1.360(CFS)
' ' flow top width = 4.383(Ft.)
' ' velocity= 5.549(Ft/s)
' ' area = 0.245(Sq.Ft)
' ' Froude number = 4.135

Upstream point elevation = 614.500(Ft.)
Downstream point elevation = 555.700(Ft.)
Flow length = 225.000(Ft.)

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Travel time = 0.68 min.
Time of concentration = 8.56 min.
Depth of flow = 0.112(Ft.)
Average velocity = 5.549(Ft/s)
Total irregular channel flow = 1.360(CFS)
Irregular channel normal depth above invert elev. = 0.112(Ft.)
Average velocity of channel(s) = 5.549(Ft/s)

+++++
Process from Point/Station 1.311 to Point/Station 1.331
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 2 in normal stream number 2
Stream flow area = 0.590(Ac.)
Runoff from this stream = 1.360(CFS)
Time of concentration = 8.56 min.
Rainfall intensity = 6.055(In/Hr)
Summary of stream data:

| Stream No. | Flow rate (CFS) | TC (min) | Rainfall Intensity (In/Hr) |
|------------|-----------------|----------|----------------------------|
| 1 | 7.186 | 9.60 | 5.623 |
| 2 | 1.360 | 8.56 | 6.055 |
| Qmax(1) = | | | |
| | 1.000 * | 1.000 * | 7.186) + |
| | 0.929 * | 1.000 * | 1.360) + = 8.448 |
| Qmax(2) = | | | |
| | 1.000 * | 0.891 * | 7.186) + |
| | 1.000 * | 1.000 * | 1.360) + = 7.766 |

Total of 2 streams to confluence:

Flow rates before confluence point:

7.186 1.360

Maximum flow rates at confluence using above data:

8.448 7.766

Area of streams before confluence:

4.260 0.590

Results of confluence:

Total flow rate = 8.448(CFS)

Time of concentration = 9.598 min.

Effective stream area after confluence = 4.850(Ac.)

+++++
Process from Point/Station 1.331 to Point/Station 1.333
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

Estimated mean flow rate at midpoint of channel = 11.066(CFS)
Depth of flow = 0.679(Ft.), Average velocity = 10.443(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :
Point number 'X' coordinate 'Y' coordinate

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

| | | |
|---|-------|------|
| 1 | 0.00 | 5.00 |
| 2 | 11.40 | 0.00 |
| 3 | 23.00 | 5.00 |

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 11.066(CFS)
' flow top width = 3.122(Ft.)
' velocity= 10.443(Ft/s)
' area = 1.060(Sq.Ft)
' Froude number = 3.159

Upstream point elevation = 555.700(Ft.)
Downstream point elevation = 507.000(Ft.)
Flow length = 520.000(Ft.)
Travel time = 0.83 min.
Time of concentration = 10.43 min.
Depth of flow = 0.679(Ft.)
Average velocity = 10.443(Ft/s)
Total irregular channel flow = 11.066(CFS)
Irregular channel normal depth above invert elev. = 0.679(Ft.)
Average velocity of channel(s) = 10.443(Ft/s)

Adding area flow to channel

Rainfall intensity (I) = 5.330(In/Hr) for a 100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000

[UNDISTURBED NATURAL TERRAIN]
(Permanent Open Space)
Impervious value, Ai = 0.000
Sub-Area C Value = 0.300
Rainfall intensity = 5.330(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.304 CA = 2.555
Subarea runoff = 5.171(CFS) for 3.550(Ac.)
Total runoff = 13.620(CFS) Total area = 8.400(Ac.)
Depth of flow = 0.734(Ft.), Average velocity = 10.999(Ft/s)

+++++
Process from Point/Station 1.291 to Point/Station 1.333
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:

In Main Stream number: 2
Stream flow area = 8.400(Ac.)
Runoff from this stream = 13.620(CFS)
Time of concentration = 10.43 min.
Rainfall intensity = 5.330(In/Hr)
Summary of stream data:

| Stream No. | Flow rate (CFS) | TC (min) | Rainfall Intensity (In/Hr) |
|------------|-----------------|----------|----------------------------|
|------------|-----------------|----------|----------------------------|

| | | | |
|---|---------|-------|-------|
| 1 | 122.778 | 12.66 | 4.704 |
|---|---------|-------|-------|

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

2 13.620 10.43 5.330
Qmax(1) =
 1.000 * 1.000 * 122.778) +
 0.883 * 1.000 * 13.620) + = 134.800
Qmax(2) =
 1.000 * 0.824 * 122.778) +
 1.000 * 1.000 * 13.620) + = 114.792

Total of 2 main streams to confluence:

Flow rates before confluence point:
 122.778 13.620

Maximum flow rates at confluence using above data:
 134.800 114.792

Area of streams before confluence:
 76.920 8.400

Results of confluence:

Total flow rate = 134.800(CFS)
Time of concentration = 12.655 min.
Effective stream area after confluence = 85.320(Ac.)

+++++
Process from Point/Station 1.333 to Point/Station 1.352
***** IRREGULAR CHANNEL FLOW TRAVEL TIME *****

Depth of flow = 1.471(Ft.), Average velocity = 11.961(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
| 1 | 0.00 | 5.00 |
| 2 | 23.90 | 0.00 |
| 3 | 52.10 | 5.00 |

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 134.800(CFS)
 ' flow top width = 15.325(Ft.)
 ' velocity= 11.961(Ft/s)
 ' area = 11.270(Sq.Ft)
 ' Froude number = 2.458

Upstream point elevation = 507.000(Ft.)

Downstream point elevation = 499.000(Ft.)

Flow length = 200.000(Ft.)

Travel time = 0.28 min.

Time of concentration = 12.93 min.

Depth of flow = 1.471(Ft.)

Average velocity = 11.961(Ft/s)

Total irregular channel flow = 134.800(CFS)

Irregular channel normal depth above invert elev. = 1.471(Ft.)

Average velocity of channel(s) = 11.961(Ft/s)

+++++

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Process from Point/Station 1.011 to Point/Station 1.352
***** CONFLUENCE OF MINOR STREAMS *****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 85.320(Ac.)
Runoff from this stream = 134.800(CFS)
Time of concentration = 12.93 min.
Rainfall intensity = 4.639(In/Hr)

+++++
Process from Point/Station 1.341 to Point/Station 1.351
***** INITIAL AREA EVALUATION *****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[UNDISTURBED NATURAL TERRAIN]
(Permanent Open Space)
Impervious value, Ai = 0.000
Sub-Area C Value = 0.300
Initial subarea total flow distance = 100.000(Ft.)
Highest elevation = 642.000(Ft.)
Lowest elevation = 632.000(Ft.)
Elevation difference = 10.000(Ft.) Slope = 10.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 10.00 %, in a development type of
Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration = 6.68 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^0.5]/(% slope^(1/3))
TC = [1.8*(1.1-0.300)*(100.000^0.5)/(10.000^(1/3))] = 6.68
Rainfall intensity (I) = 7.101(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.300
Subarea runoff = 0.852(CFS)
Total initial stream area = 0.400(Ac.)

+++++
Process from Point/Station 1.351 to Point/Station 1.352
***** IRREGULAR CHANNEL FLOW TRAVEL TIME *****

Estimated mean flow rate at midpoint of channel = 9.689(CFS)
Depth of flow = 0.458(Ft.), Average velocity = 11.182(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :
Point number 'X' coordinate 'Y' coordinate
1 0.00 5.00
2 18.30 3.00
3 37.30 2.00
4 47.30 0.00
5 60.40 4.00
6 80.10 5.00

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 9.689(CFS)
' ' flow top width = 3.787(Ft.)
' ' velocity= 11.182(Ft/s)
' ' area = 0.866(Sq.Ft)
' ' Froude number = 4.120

Upstream point elevation = 632.000(Ft.)

Downstream point elevation = 499.000(Ft.)

Flow length = 790.000(Ft.)

Travel time = 1.18 min.

Time of concentration = 7.86 min.

Depth of flow = 0.458(Ft.)

Average velocity = 11.182(Ft/s)

Total irregular channel flow = 9.689(CFS)

Irregular channel normal depth above invert elev. = 0.458(Ft.)

Average velocity of channel(s) = 11.182(Ft/s)

Adding area flow to channel

Rainfall intensity (I) = 6.395(In/Hr) for a 100.0 year storm

Decimal fraction soil group A = 0.000

Decimal fraction soil group B = 0.000

Decimal fraction soil group C = 1.000

Decimal fraction soil group D = 0.000

[UNDISTURBED NATURAL TERRAIN]

(Permanent Open Space)

Impervious value, Ai = 0.000

Sub-Area C Value = 0.300

Rainfall intensity = 6.395(In/Hr) for a 100.0 year storm

Effective runoff coefficient used for total area

(Q=KCIA) is C = 0.300 CA = 2.886

Subarea runoff = 17.605(CFS) for 9.220(Ac.)

Total runoff = 18.457(CFS) Total area = 9.620(Ac.)

Depth of flow = 0.583(Ft.), Average velocity = 13.137(Ft/s)

+++++
Process from Point/Station 1.341 to Point/Station 1.352

**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2

Stream flow area = 9.620(Ac.)

Runoff from this stream = 18.457(CFS)

Time of concentration = 7.86 min.

Rainfall intensity = 6.395(In/Hr)

Summary of stream data:

| Stream No. | Flow rate (CFS) | TC (min) | Rainfall Intensity (In/Hr) |
|------------|-----------------|-------------|----------------------------|
| 1 | 134.800 | 12.93 | 4.639 |
| 2 | 18.457 | 7.86 | 6.395 |
| Qmax(1) = | | | |
| | 1.000 * 1.000 * | 134.800) + | |
| | 0.725 * 1.000 * | 18.457) + = | 148.187 |

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

$Q_{max}(2) =$
1.000 * 0.608 * 134.800) +
1.000 * 1.000 * 18.457) + = 100.389

Total of 2 streams to confluence:

Flow rates before confluence point:
134.800 18.457

Maximum flow rates at confluence using above data:
148.187 100.389

Area of streams before confluence:
85.320 9.620

Results of confluence:

Total flow rate = 148.187(CFS)

Time of concentration = 12.934 min.

Effective stream area after confluence = 94.940(Ac.)

+++++
Process from Point/Station 1.352 to Point/Station 1.372

**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

Depth of flow = 1.735(Ft.), Average velocity = 9.444(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
| 1 | 0.00 | 5.00 |
| 2 | 23.90 | 0.00 |
| 3 | 52.10 | 5.00 |

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 148.187(CFS)
' flow top width = 18.083(Ft.)
' velocity= 9.444(Ft/s)
' area = 15.691(Sq.Ft)
' Froude number = 1.787

Upstream point elevation = 499.000(Ft.)

Downstream point elevation = 494.000(Ft.)

Flow length = 250.000(Ft.)

Travel time = 0.44 min.

Time of concentration = 13.38 min.

Depth of flow = 1.735(Ft.)

Average velocity = 9.444(Ft/s)

Total irregular channel flow = 148.187(CFS)

Irregular channel normal depth above invert elev. = 1.735(Ft.)

Average velocity of channel(s) = 9.444(Ft/s)

+++++
Process from Point/Station 1.011 to Point/Station 1.372

**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1

Stream flow area = 94.940(Ac.)

Runoff from this stream = 148.187(CFS)

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Time of concentration = 13.38 min.
Rainfall intensity = 4.539(In/Hr)

+++++
Process from Point/Station 1.361 to Point/Station 1.371
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[UNDISTURBED NATURAL TERRAIN]
(Permanent Open Space)
Impervious value, Ai = 0.000
Sub-Area C Value = 0.300
Initial subarea total flow distance = 100.000(Ft.)
Highest elevation = 587.000(Ft.)
Lowest elevation = 582.000(Ft.)
Elevation difference = 5.000(Ft.) Slope = 5.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 5.00 %, in a development type of
Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration = 8.42 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3))]
TC = [1.8*(1.1-0.300)*(100.000^.5)/(5.000^(1/3))] = 8.42
Rainfall intensity (I) = 6.118(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.300
Subarea runoff = 0.422(CFS)
Total initial stream area = 0.230(Ac.)

+++++
Process from Point/Station 1.371 to Point/Station 1.372
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

Estimated mean flow rate at midpoint of channel = 3.581(CFS)
Depth of flow = 0.175(Ft.), Average velocity = 5.953(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :
Point number 'X' coordinate 'Y' coordinate
1 0.00 2.00
2 27.00 0.00
3 78.90 2.00
Manning's 'N' friction factor = 0.020

Sub-Channel flow = 3.581(CFS)
' flow top width = 6.889(Ft.)
' velocity= 5.953(Ft/s)
' area = 0.602(Sq.Ft)
' Froude number = 3.550

Upstream point elevation = 582.000(Ft.)

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Downstream point elevation = 494.000(Ft.)
Flow length = 530.000(Ft.)
Travel time = 1.48 min.
Time of concentration = 9.90 min.
Depth of flow = 0.175(Ft.)
Average velocity = 5.953(Ft/s)
Total irregular channel flow = 3.581(CFS)
Irregular channel normal depth above invert elev. = 0.175(Ft.)
Average velocity of channel(s) = 5.953(Ft/s)
Adding area flow to channel
Rainfall intensity (I) = 5.510(In/Hr) for a 100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[UNDISTURBED NATURAL TERRAIN]
(Permanent Open Space)
Impervious value, Ai = 0.000
Sub-Area C Value = 0.300
Rainfall intensity = 5.510(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.300 CA = 1.206
Subarea runoff = 6.223(CFS) for 3.790(Ac.)
Total runoff = 6.645(CFS) Total area = 4.020(Ac.)
Depth of flow = 0.220(Ft.), Average velocity = 6.948(Ft/s)

+++++
Process from Point/Station 1.361 to Point/Station 1.372
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 4.020(Ac.)
Runoff from this stream = 6.645(CFS)
Time of concentration = 9.90 min.
Rainfall intensity = 5.510(In/Hr)
Summary of stream data:

| Stream No. | Flow rate (CFS) | TC (min) | Rainfall Intensity (In/Hr) |
|------------|-----------------|------------|----------------------------|
| 1 | 148.187 | 13.38 | 4.539 |
| 2 | 6.645 | 9.90 | 5.510 |
| Qmax(1) = | | | |
| | 1.000 * 1.000 * | 148.187) + | |
| | 0.824 * 1.000 * | 6.645) + = | 153.661 |
| Qmax(2) = | | | |
| | 1.000 * 0.741 * | 148.187) + | |
| | 1.000 * 1.000 * | 6.645) + = | 116.384 |

Total of 2 streams to confluence:
Flow rates before confluence point:
148.187 6.645
Maximum flow rates at confluence using above data:
153.661 116.384

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

Area of streams before confluence:
94.940 4.020
Results of confluence:
Total flow rate = 153.661(CFS)
Time of concentration = 13.375 min.
Effective stream area after confluence = 98.960(Ac.)

+++++
Process from Point/Station 1.372 to Point/Station 1.373
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

Depth of flow = 1.627(Ft.), Average velocity = 14.994(Ft/s)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :
Point number 'X' coordinate 'Y' coordinate
1 0.00 5.00
2 17.20 0.00
3 38.70 5.00

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 153.661(CFS)
' flow top width = 12.595(Ft.)
' velocity= 14.994(Ft/s)
' area = 10.248(Sq.Ft)
' Froude number = 2.929

Upstream point elevation = 494.000(Ft.)
Downstream point elevation = 487.000(Ft.)
Flow length = 125.000(Ft.)
Travel time = 0.14 min.
Time of concentration = 13.51 min.
Depth of flow = 1.627(Ft.)
Average velocity = 14.994(Ft/s)
Total irregular channel flow = 153.661(CFS)
Irregular channel normal depth above invert elev. = 1.627(Ft.)
Average velocity of channel(s) = 14.994(Ft/s)

+++++
Process from Point/Station 1.011 to Point/Station 1.373
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:

In Main Stream number: 1
Stream flow area = 98.960(Ac.)
Runoff from this stream = 153.661(CFS)
Time of concentration = 13.51 min.
Rainfall intensity = 4.509(In/Hr)
Summary of stream data:

| Stream No. | Flow rate (CFS) | TC (min) | Rainfall Intensity (In/Hr) |
|------------|-----------------|----------|----------------------------|
|------------|-----------------|----------|----------------------------|

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

1 153.661 13.51 4.509
Qmax(1) =
 1.000 * 1.000 * 153.661) + = 153.661

Total of 1 main streams to confluence:

Flow rates before confluence point:
 153.661

Maximum flow rates at confluence using above data:
 153.661

Area of streams before confluence:
 98.960

Results of confluence:

Total flow rate = 153.661(CFS)

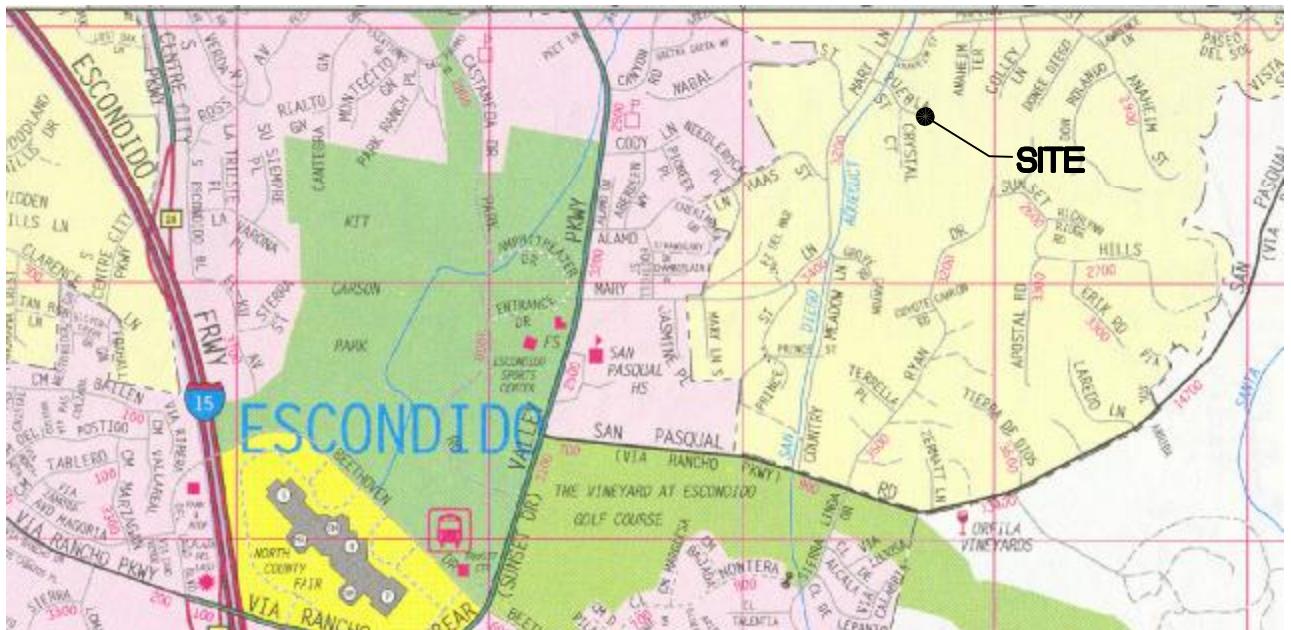
Time of concentration = 13.514 min.

Effective stream area after confluence = 98.960(Ac.)
End of computations, total study area = 98.960 (Ac.)

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

ATTACHMENT 4: HYDROLOGY STUDY EXHIBITS

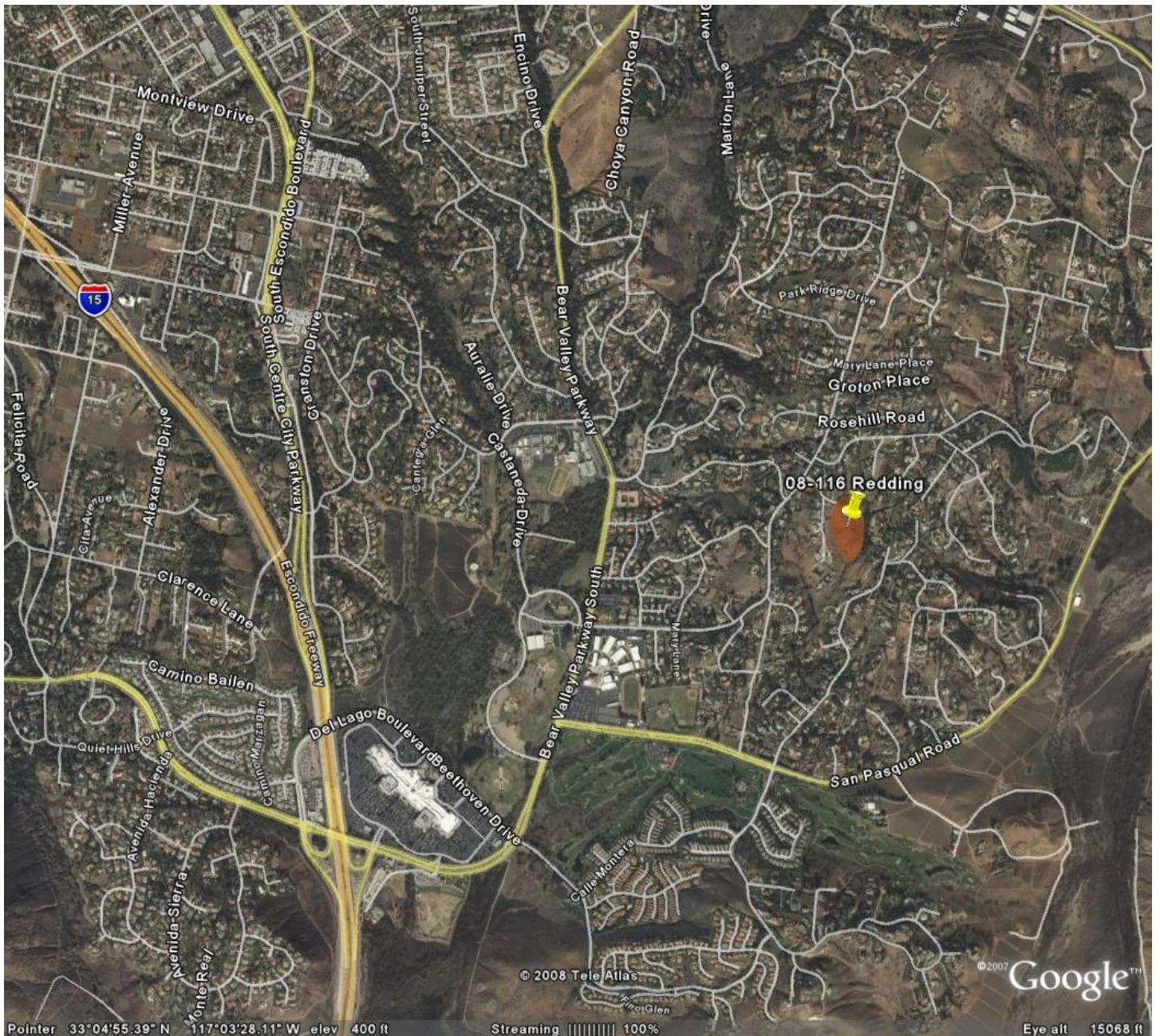
Please see the attached Hydrology Study Exhibits.



VICINITY MAP

N.T.S.

T.B. PAGE 1150
GRID: D-1



GOOGLE EARTH VICINITY MAP

N.T.S.

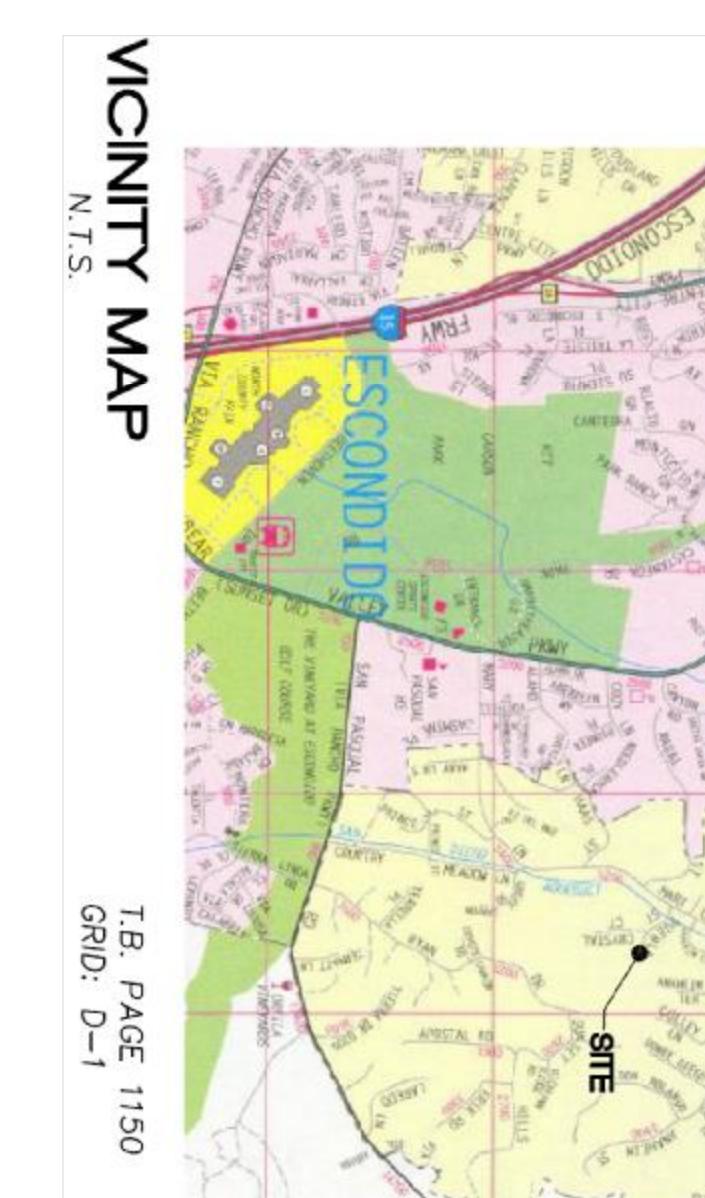


ROUGH STUDY AREA VIEWED WITH GOOGLE EARTH

N.T.S.

**PRELIMINARY HYDROLOGY STUDY EXISTING CONDITIONS EXHIBIT FOR:
REDDING MINOR SUBDIVISION - TPM 2112**

NODE KEY
 1.09
 1.91
 NODE NUMBER
 BASIN NUMBER



| EXISTING CONDITIONS NODE SUMMARY | |
|----------------------------------|-----------|
| NAME | ELEVATION |
| 1.01 | 650.0 |
| 1.011 | 760.0 |
| 1.021 | 753.0 |
| 1.031 | 697.0 |
| 1.041 | 694.0 |
| 1.051 | 679.0 |
| 1.061 | 679.0 |
| 1.071 | 679.0 |
| 1.081 | 685.0 |
| 1.091 | 679.0 |
| 1.101 | 664.0 |
| 1.111 | 670.0 |
| 1.121 | 673.0 |
| 1.131 | 659.0 |
| 1.141 | 654.0 |
| 1.151 | 674.0 |
| 1.161 | 674.0 |
| 1.171 | 674.0 |
| 1.181 | 674.0 |
| 1.191 | 674.0 |
| 1.201 | 674.0 |
| 1.211 | 674.0 |
| 1.221 | 674.0 |
| 1.231 | 674.0 |
| 1.241 | 674.0 |
| 1.251 | 674.0 |
| 1.261 | 674.0 |
| 1.271 | 674.0 |
| 1.281 | 674.0 |
| 1.291 | 674.0 |
| 1.301 | 674.0 |
| 1.311 | 674.0 |
| 1.321 | 674.0 |
| 1.331 | 674.0 |
| 1.341 | 674.0 |
| 1.351 | 674.0 |
| 1.361 | 674.0 |
| 1.371 | 674.0 |
| 1.381 | 674.0 |
| 1.391 | 674.0 |
| 1.401 | 674.0 |
| 1.411 | 674.0 |
| 1.421 | 674.0 |
| 1.431 | 674.0 |
| 1.441 | 674.0 |
| 1.451 | 674.0 |
| 1.461 | 674.0 |
| 1.471 | 674.0 |
| 1.481 | 674.0 |
| 1.491 | 674.0 |
| 1.501 | 674.0 |
| 1.511 | 674.0 |
| 1.521 | 674.0 |
| 1.531 | 674.0 |
| 1.541 | 674.0 |
| 1.551 | 674.0 |
| 1.561 | 674.0 |
| 1.571 | 674.0 |
| 1.581 | 674.0 |
| 1.591 | 674.0 |
| 1.601 | 674.0 |
| 1.611 | 674.0 |
| 1.621 | 674.0 |
| 1.631 | 674.0 |
| 1.641 | 674.0 |
| 1.651 | 674.0 |
| 1.661 | 674.0 |
| 1.671 | 674.0 |
| 1.681 | 674.0 |
| 1.691 | 674.0 |
| 1.701 | 674.0 |
| 1.711 | 674.0 |
| 1.721 | 674.0 |
| 1.731 | 674.0 |
| 1.741 | 674.0 |
| 1.751 | 674.0 |
| 1.761 | 674.0 |
| 1.771 | 674.0 |
| 1.781 | 674.0 |
| 1.791 | 674.0 |
| 1.801 | 674.0 |
| 1.811 | 674.0 |
| 1.821 | 674.0 |
| 1.831 | 674.0 |
| 1.841 | 674.0 |
| 1.851 | 674.0 |
| 1.861 | 674.0 |
| 1.871 | 674.0 |
| 1.881 | 674.0 |
| 1.891 | 674.0 |
| 1.901 | 674.0 |
| 1.911 | 674.0 |
| 1.921 | 674.0 |
| 1.931 | 674.0 |
| 1.941 | 674.0 |
| 1.951 | 674.0 |
| 1.961 | 674.0 |
| 1.971 | 674.0 |
| 1.981 | 674.0 |
| 1.991 | 674.0 |
| 1.001 | 674.0 |
| 1.011 | 674.0 |
| 1.021 | 674.0 |
| 1.031 | 674.0 |
| 1.041 | 674.0 |
| 1.051 | 674.0 |
| 1.061 | 674.0 |
| 1.071 | 674.0 |
| 1.081 | 674.0 |
| 1.091 | 674.0 |
| 1.101 | 674.0 |
| 1.111 | 674.0 |
| 1.121 | 674.0 |
| 1.131 | 674.0 |
| 1.141 | 674.0 |
| 1.151 | 674.0 |
| 1.161 | 674.0 |
| 1.171 | 674.0 |
| 1.181 | 674.0 |
| 1.191 | 674.0 |
| 1.201 | 674.0 |
| 1.211 | 674.0 |
| 1.221 | 674.0 |
| 1.231 | 674.0 |
| 1.241 | 674.0 |
| 1.251 | 674.0 |
| 1.261 | 674.0 |
| 1.271 | 674.0 |
| 1.281 | 674.0 |
| 1.291 | 674.0 |
| 1.301 | 674.0 |
| 1.311 | 674.0 |
| 1.321 | 674.0 |
| 1.331 | 674.0 |
| 1.341 | 674.0 |
| 1.351 | 674.0 |
| 1.361 | 674.0 |
| 1.371 | 674.0 |
| 1.381 | 674.0 |
| 1.391 | 674.0 |
| 1.401 | 674.0 |
| 1.411 | 674.0 |
| 1.421 | 674.0 |
| 1.431 | 674.0 |
| 1.441 | 674.0 |
| 1.451 | 674.0 |
| 1.461 | 674.0 |
| 1.471 | 674.0 |
| 1.481 | 674.0 |
| 1.491 | 674.0 |
| 1.501 | 674.0 |
| 1.511 | 674.0 |
| 1.521 | 674.0 |
| 1.531 | 674.0 |
| 1.541 | 674.0 |
| 1.551 | 674.0 |
| 1.561 | 674.0 |
| 1.571 | 674.0 |
| 1.581 | 674.0 |
| 1.591 | 674.0 |
| 1.601 | 674.0 |
| 1.611 | 674.0 |
| 1.621 | 674.0 |
| 1.631 | 674.0 |
| 1.641 | 674.0 |
| 1.651 | 674.0 |
| 1.661 | 674.0 |
| 1.671 | 674.0 |
| 1.681 | 674.0 |
| 1.691 | 674.0 |
| 1.701 | 674.0 |
| 1.711 | 674.0 |
| 1.721 | 674.0 |
| 1.731 | 674.0 |
| 1.741 | 674.0 |
| 1.751 | 674.0 |
| 1.761 | 674.0 |
| 1.771 | 674.0 |
| 1.781 | 674.0 |
| 1.791 | 674.0 |
| 1.801 | 674.0 |
| 1.811 | 674.0 |
| 1.821 | 674.0 |
| 1.831 | 674.0 |
| 1.841 | 674.0 |
| 1.851 | 674.0 |
| 1.861 | 674.0 |
| 1.871 | 674.0 |
| 1.881 | 674.0 |
| 1.891 | 674.0 |
| 1.901 | 674.0 |
| 1.911 | 674.0 |
| 1.921 | 674.0 |
| 1.931 | 674.0 |
| 1.941 | 674.0 |
| 1.951 | 674.0 |
| 1.961 | 674.0 |
| 1.971 | 674.0 |
| 1.981 | 674.0 |
| 1.991 | 674.0 |
| 1.001 | 674.0 |
| 1.011 | 674.0 |
| 1.021 | 674.0 |
| 1.031 | 674.0 |
| 1.041 | 674.0 |
| 1.051 | 674.0 |
| 1.061 | 674.0 |
| 1.071 | 674.0 |
| 1.081 | 674.0 |
| 1.091 | 674.0 |
| 1.101 | 674.0 |
| 1.111 | 674.0 |
| 1.121 | 674.0 |
| 1.131 | 674.0 |
| 1.141 | 674.0 |
| 1.151 | 674.0 |
| 1.161 | 674.0 |
| 1.171 | 674.0 |
| 1.181 | 674.0 |
| 1.191 | 674.0 |
| 1.201 | 674.0 |
| 1.211 | 674.0 |
| 1.221 | 674.0 |
| 1.231 | 674.0 |
| 1.241 | 674.0 |
| 1.251 | 674.0 |
| 1.261 | 674.0 |
| 1.271 | 674.0 |
| 1.281 | 674.0 |
| 1.291 | 674.0 |
| 1.301 | 674.0 |
| 1.311 | 674.0 |
| 1.321 | 674.0 |
| 1.331 | 674.0 |
| 1.341 | 674.0 |
| 1.351 | 674.0 |
| 1.361 | 674.0 |
| 1.371 | 674.0 |
| 1.381 | 674.0 |
| 1.391 | 674.0 |
| 1.401 | 674.0 |
| 1.411 | 674.0 |
| 1.421 | 674.0 |
| 1.431 | 674.0 |
| 1.441 | 674.0 |
| 1.451 | 674.0 |
| 1.461 | 674.0 |
| 1.471 | 674.0 |
| 1.481 | 674.0 |
| 1.491 | 674.0 |
| 1.501 | 674.0 |
| 1.511 | 674.0 |
| 1.521 | 674.0 |
| 1.531 | 674.0 |
| 1.541 | 674.0 |
| 1.551 | 674.0 |
| 1.561 | 674.0 |
| 1.571 | 674.0 |
| 1.581 | 674.0 |
| 1.591 | 674.0 |
| 1.601 | 674.0 |
| 1.611 | 674.0 |
| 1.621 | 674.0 |
| 1.631 | 674.0 |
| 1.641 | 674.0 |
| 1.651 | 674.0 |
| 1.661 | 674.0 |
| 1.671 | 674.0 |
| 1.681 | 674.0 |
| 1.691 | 674.0 |
| 1.701 | 674.0 |
| 1.711 | 674.0 |
| 1.721 | 674.0 |
| 1.731 | 674.0 |
| 1.741 | 674.0 |
| 1.751 | 674.0 |
| 1.761 | 674.0 |
| 1.771 | 674.0 |
| 1.781 | 674.0 |
| 1.791 | 674.0 |
| 1.801 | 674.0 |
| 1.811 | 674.0 |
| 1.821 | 674.0 |
| 1.831 | 674.0 |
| 1.841 | 674.0 |
| 1.851 | 674.0 |
| 1.861 | 674.0 |
| 1.871 | 674.0 |
| 1.881 | 674.0 |
| 1.891 | 674.0 |
| 1.901 | 674.0 |
| 1.911 | 674.0 |
| 1.921 | 674.0 |
| 1.931 | 674.0 |
| 1.941 | 674.0 |
| 1.951 | 674.0 |
| 1.961 | 674.0 |
| 1.971 | 674.0 |
| 1.981 | 674.0 |
| 1.991 | 674.0 |
| 1.001 | 674.0 |
| 1.011 | 674.0 |
| | |

**PRELIMINARY HYDROLOGY STUDY
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ATTACHMENT 5: 100-YEAR INUNDATION AREA CALCULATIONS

SECTION 1

CIVILCADD/CIVILDESIGN Engineering Software, (c) 2004 Version 7.0

Program License Serial Number 6170

*** Irregular Channel Analysis ***

Upstream (headworks) Elevation = 551.000(Ft.)

Downstream (outlet) Elevation = 542.000(Ft.)

Runoff/Flow Distance = 220.000(Ft.)

Maximum flow rate in channel(s) = 69.723(CFS)

Depth of flow = 0.917(Ft.)

Average velocity = 10.593(Ft/s)

Total flow rate in 1/2 street = 69.723(CFS)

***** Irregular Channel Data *****

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
|--------------|----------------|----------------|

| | | |
|----|-------|------|
| 1 | 0.00 | 4.24 |
| 2 | 2.00 | 3.82 |
| 3 | 4.00 | 3.41 |
| 4 | 6.00 | 3.00 |
| 5 | 8.00 | 2.60 |
| 6 | 10.00 | 2.20 |
| 7 | 12.00 | 1.80 |
| 8 | 14.00 | 1.40 |
| 9 | 16.00 | 1.00 |
| 10 | 18.00 | 0.59 |
| 11 | 20.00 | 0.18 |
| 12 | 22.00 | 0.00 |
| 13 | 24.00 | 0.00 |
| 14 | 26.00 | 0.40 |
| 15 | 28.00 | 1.19 |
| 16 | 30.00 | 1.98 |
| 17 | 32.00 | 2.77 |
| 18 | 34.00 | 3.56 |
| 19 | 36.00 | 4.35 |

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 69.723(CFS)

flow top width = 10.902(Ft.)

wetted perimeter = 11.123(Ft.)

velocity= 10.593(Ft/s)

area = 6.582(Sq.Ft)

Froude number = 2.402

Upstream point elevation = 551.000(Ft.)

Downstream point elevation = 542.000(Ft.)

Flow length = 220.000(Ft.)

Depth of flow = 0.917(Ft.)

Average velocity = 10.593(Ft/s)

Total irregular channel flow = 69.723(CFS)

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Irregular channel normal depth above invert elev. = 0.917(Ft.)
Average velocity of channel(s) = 10.593(Ft/s)

Sub-Channel No. 1 Critical depth = 1.422(Ft.)
' ' ' Critical flow top width = 14.696(Ft.)
' ' ' Critical flow velocity= 5.345(Ft/s)
' ' ' Critical flow area = 13.046(Sq.Ft)

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**PRELIMINARY HYDROLOGY STUDY
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SECTION 2

CIVILCADD/CIVILDESIGN Engineering Software, (c) 2004 Version 7.0

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*** Irregular Channel Analysis ***

Upstream (headworks) Elevation = 551.000(Ft.)
Downstream (outlet) Elevation = 542.000(Ft.)
Runoff/Flow Distance = 220.000(Ft.)
Maximum flow rate in channel(s) = 69.723(CFS)

Depth of flow = 0.258(Ft.)
Average velocity = 5.987(Ft/s)
Total flow rate in 1/2 street = 69.723(CFS)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
| 1 | 0.00 | 5.24 |
| 2 | 1.00 | 4.77 |
| 3 | 2.00 | 4.33 |
| 4 | 3.00 | 3.88 |
| 5 | 4.00 | 3.43 |
| 6 | 5.00 | 2.97 |
| 7 | 6.00 | 2.52 |
| 8 | 7.00 | 2.06 |
| 9 | 8.00 | 1.60 |
| 10 | 9.00 | 1.14 |
| 11 | 10.00 | 0.68 |
| 12 | 11.00 | 0.23 |
| 13 | 12.00 | 0.00 |
| 14 | 56.00 | 0.00 |
| 15 | 64.00 | 1.74 |
| 16 | 71.00 | 3.11 |
| 17 | 75.00 | 3.94 |
| 18 | 77.00 | 4.31 |
| 19 | 81.00 | 4.92 |
| 20 | 83.00 | 5.57 |

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 69.723(CFS)
' ' flow top width = 46.248(Ft.)
' ' wetted perimeter = 46.308(Ft.)
' ' velocity= 5.987(Ft/s)
' ' area = 11.645(Sq.Ft)
' ' Froude number = 2.103

Upstream point elevation = 551.000(Ft.)
Downstream point elevation = 542.000(Ft.)
Flow length = 220.000(Ft.)
Depth of flow = 0.258(Ft.)
Average velocity = 5.987(Ft/s)
Total irregular channel flow = 69.723(CFS)

**PRELIMINARY HYDROLOGY STUDY
REDDING MINOR SUBDIVISION (TPM 21112)
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Irregular channel normal depth above invert elev. = 0.258(Ft.)
Average velocity of channel(s) = 5.987(Ft/s)

Sub-Channel No. 1 Critical depth = 0.422(Ft.)
' ' ' Critical flow top width = 47.366(Ft.)
' ' ' Critical flow velocity= 3.609(Ft/s)
' ' ' Critical flow area = 19.319(Sq.Ft)

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**PRELIMINARY HYDROLOGY STUDY
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SECTION 3

CIVILCADD/CIVILDESIGN Engineering Software, (c) 2004 Version 7.0

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*** Irregular Channel Analysis ***

Upstream (headworks) Elevation = 551.000(Ft.)
Downstream (outlet) Elevation = 542.000(Ft.)
Runoff/Flow Distance = 220.000(Ft.)
Maximum flow rate in channel(s) = 69.723(CFS)

Depth of flow = 0.225(Ft.)
Average velocity = 5.499(Ft/s)
Total flow rate in 1/2 street = 69.723(CFS)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
| 1 | 0.00 | 5.30 |
| 2 | 3.75 | 4.00 |
| 3 | 6.77 | 3.00 |
| 4 | 9.63 | 2.00 |
| 5 | 12.49 | 1.00 |
| 6 | 15.35 | 0.00 |
| 7 | 71.00 | 0.00 |
| 8 | 75.10 | 1.00 |
| 9 | 79.40 | 2.00 |
| 10 | 84.51 | 3.00 |
| 11 | 89.61 | 4.00 |
| 12 | 94.72 | 5.00 |

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 69.723(CFS)
' ' flow top width = 57.214(Ft.)
' ' wetted perimeter = 57.279(Ft.)
' ' velocity= 5.499(Ft/s)
' ' area = 12.679(Sq.Ft)
' ' Froude number = 2.059

Upstream point elevation = 551.000(Ft.)
Downstream point elevation = 542.000(Ft.)
Flow length = 220.000(Ft.)
Depth of flow = 0.225(Ft.)
Average velocity = 5.499(Ft/s)
Total irregular channel flow = 69.723(CFS)
Irregular channel normal depth above invert elev. = 0.225(Ft.)
Average velocity of channel(s) = 5.499(Ft/s)

Sub-Channel No. 1 Critical depth = 0.363(Ft.)
' ' ' Critical flow top width = 58.178(Ft.)
' ' ' Critical flow velocity= 3.372(Ft/s)
' ' ' Critical flow area = 20.676(Sq.Ft)

**PRELIMINARY HYDROLOGY STUDY
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SECTION 4

CIVILCADD/CIVILDESIGN Engineering Software, (c) 2004 Version 7.0

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*** Irregular Channel Analysis ***

Upstream (headworks) Elevation = 542.000(Ft.)
Downstream (outlet) Elevation = 537.000(Ft.)
Runoff/Flow Distance = 250.000(Ft.)
Maximum flow rate in channel(s) = 99.854(CFS)

Depth of flow = 0.401(Ft.)
Average velocity = 5.613(Ft/s)
Total flow rate in 1/2 street = 99.854(CFS)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
| 1 | 0.00 | 3.00 |
| 2 | 2.56 | 2.00 |
| 3 | 5.03 | 1.00 |
| 4 | 7.50 | 0.00 |
| 5 | 50.86 | 0.00 |
| 6 | 53.50 | 1.00 |
| 7 | 56.14 | 2.00 |
| 8 | 58.79 | 3.00 |

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 99.854(CFS)
' ' flow top width = 45.408(Ft.)
' ' wetted perimeter = 45.559(Ft.)
' ' velocity= 5.613(Ft/s)
' ' area = 17.789(Sq.Ft)
' ' Froude number = 1.580

Upstream point elevation = 542.000(Ft.)
Downstream point elevation = 537.000(Ft.)
Flow length = 250.000(Ft.)
Depth of flow = 0.401(Ft.)
Average velocity = 5.613(Ft/s)
Total irregular channel flow = 99.854(CFS)
Irregular channel normal depth above invert elev. = 0.401(Ft.)
Average velocity of channel(s) = 5.613(Ft/s)

Sub-Channel No. 1 Critical depth = 0.539(Ft.)
' ' Critical flow top width = 46.115(Ft.)
' ' Critical flow velocity= 4.141(Ft/s)
' ' Critical flow area = 24.116(Sq.Ft)

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SECTION 5

CIVILCADD/CIVILDESIGN Engineering Software, (c) 2004 Version 7.0

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*** Irregular Channel Analysis ***

Upstream (headworks) Elevation = 542.000(Ft.)
Downstream (outlet) Elevation = 537.000(Ft.)
Runoff/Flow Distance = 250.000(Ft.)
Maximum flow rate in channel(s) = 99.854(CFS)

Depth of flow = 1.433(Ft.)
Average velocity = 8.250(Ft/s)
Total flow rate in 1/2 street = 99.854(CFS)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
| 1 | 0.00 | 4.83 |
| 2 | 3.31 | 3.83 |
| 3 | 7.45 | 2.83 |
| 4 | 12.43 | 1.83 |
| 5 | 20.60 | 0.83 |
| 6 | 27.35 | 0.00 |
| 7 | 30.28 | 0.83 |
| 8 | 34.45 | 1.83 |
| 9 | 38.69 | 2.83 |
| 10 | 43.09 | 3.83 |
| 11 | 48.65 | 4.83 |

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 99.854(CFS)
' ' flow top width = 17.126(Ft.)
' ' wetted perimeter = 17.400(Ft.)
' ' velocity= 8.250(Ft/s)
' ' area = 12.104(Sq.Ft)
' ' Froude number = 1.729

Upstream point elevation = 542.000(Ft.)
Downstream point elevation = 537.000(Ft.)
Flow length = 250.000(Ft.)
Depth of flow = 1.433(Ft.)
Average velocity = 8.250(Ft/s)
Total irregular channel flow = 99.854(CFS)
Irregular channel normal depth above invert elev. = 1.433(Ft.)
Average velocity of channel(s) = 8.250(Ft/s)

Sub-Channel No. 1 Critical depth = 1.781(Ft.)
' ' ' Critical flow top width = 21.418(Ft.)
' ' ' Critical flow velocity= 5.309(Ft/s)
' ' ' Critical flow area = 18.808(Sq.Ft)

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SECTION 6

CIVILCADD/CIVILDESIGN Engineering Software, (c) 2004 Version 7.0

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*** Irregular Channel Analysis ***

Upstream (headworks) Elevation = 537.000(Ft.)
Downstream (outlet) Elevation = 534.000(Ft.)
Runoff/Flow Distance = 150.000(Ft.)
Maximum flow rate in channel(s) = 111.121(CFS)

Depth of flow = 0.324(Ft.)
Average velocity = 4.866(Ft/s)
Total flow rate in 1/2 street = 111.121(CFS)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
| 1 | 0.00 | 3.00 |
| 2 | 2.72 | 2.00 |
| 3 | 5.53 | 1.00 |
| 4 | 8.33 | 0.00 |
| 5 | 76.98 | 0.00 |
| 6 | 85.75 | 1.00 |
| 7 | 95.26 | 2.00 |
| 8 | 104.77 | 3.00 |

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 111.121(CFS)
| flow top width = 72.397(Ft.)
| wetted perimeter = 72.471(Ft.)
| velocity= 4.866(Ft/s)
| area = 22.837(Sq.Ft)
| Froude number = 1.527

Upstream point elevation = 537.000(Ft.)
Downstream point elevation = 534.000(Ft.)
Flow length = 150.000(Ft.)
Depth of flow = 0.324(Ft.)
Average velocity = 4.866(Ft/s)
Total irregular channel flow = 111.121(CFS)
Irregular channel normal depth above invert elev. = 0.324(Ft.)
Average velocity of channel(s) = 4.866(Ft/s)

Sub-Channel No. 1 Critical depth = 0.430(Ft.)
| Critical flow top width = 73.621(Ft.)
| Critical flow velocity= 3.635(Ft/s)
| Critical flow area = 30.566(Sq.Ft)

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SECTION 7

CIVILCADD/CIVILDESIGN Engineering Software, (c) 2004 Version 7.0

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*** Irregular Channel Analysis ***

Upstream (headworks) Elevation = 537.000(Ft.)
Downstream (outlet) Elevation = 534.000(Ft.)
Runoff/Flow Distance = 150.000(Ft.)
Maximum flow rate in channel(s) = 111.210(CFS)

Depth of flow = 0.690(Ft.)
Average velocity = 5.752(Ft/s)
Total flow rate in 1/2 street = 111.210(CFS)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
| 1 | 0.00 | 3.82 |
| 2 | 6.58 | 2.82 |
| 3 | 12.26 | 1.82 |
| 4 | 17.94 | 0.82 |
| 5 | 21.82 | 0.14 |
| 6 | 33.37 | 0.00 |
| 7 | 49.37 | 0.34 |
| 8 | 72.65 | 0.82 |
| 9 | 83.57 | 1.82 |
| 10 | 94.32 | 2.82 |
| 11 | 105.21 | 3.82 |

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 111.210(CFS)
' ' flow top width = 47.687(Ft.)
' ' wetted perimeter = 47.742(Ft.)
' ' velocity= 5.752(Ft/s)
' ' area = 19.335(Sq.Ft)
' ' Froude number = 1.592

Upstream point elevation = 537.000(Ft.)
Downstream point elevation = 534.000(Ft.)
Flow length = 150.000(Ft.)
Depth of flow = 0.690(Ft.)
Average velocity = 5.752(Ft/s)
Total irregular channel flow = 111.210(CFS)
Irregular channel normal depth above invert elev. = 0.690(Ft.)
Average velocity of channel(s) = 5.752(Ft/s)

Sub-Channel No. 1 Critical depth = 0.852(Ft.)
' ' ' Critical flow top width = 55.234(Ft.)
' ' ' Critical flow velocity= 4.014(Ft/s)
' ' ' Critical flow area = 27.704(Sq.Ft)

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SECTION 8

CIVILCADD/CIVILDESIGN Engineering Software, (c) 2004 Version 7.0

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*** Irregular Channel Analysis ***

Upstream (headworks) Elevation = 527.000(Ft.)
Downstream (outlet) Elevation = 507.000(Ft.)
Runoff/Flow Distance = 390.000(Ft.)
Maximum flow rate in channel(s) = 122.778(CFS)

Depth of flow = 0.986(Ft.)
Average velocity = 11.426(Ft/s)
Total flow rate in 1/2 street = 122.778(CFS)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
| 1 | 0.00 | 4.74 |
| 2 | 2.15 | 3.74 |
| 3 | 4.30 | 2.74 |
| 4 | 6.86 | 1.74 |
| 5 | 7.16 | 1.62 |
| 6 | 8.74 | 1.66 |

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 0.000(CFS)
' ' flow top width = 0.000(Ft.)
' ' wetted perimeter = 0.000(Ft.)
' ' velocity= 0.000(Ft/s)
' ' area = 0.000(Sq.Ft)
' ' Froude number = 0.000

Information entered for subchannel number 2 :

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
| 1 | 22.05 | 0.74 |
| 2 | 32.76 | 0.00 |
| 3 | 39.06 | 0.74 |
| 4 | 47.61 | 1.74 |
| 5 | 56.15 | 2.74 |
| 6 | 69.33 | 3.74 |
| 7 | 80.35 | 4.74 |

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 122.778(CFS)
' ' flow top width = 19.117(Ft.)
' ' wetted perimeter = 19.200(Ft.)
' ' velocity= 11.426(Ft/s)
' ' area = 10.745(Sq.Ft)
' ' Froude number = 0.000

Upstream point elevation = 527.000(Ft.)
Downstream point elevation = 507.000(Ft.)
Flow length = 390.000(Ft.)

**PRELIMINARY HYDROLOGY STUDY
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Depth of flow = 0.986(Ft.)
Average velocity = 11.426(Ft/s)
Total irregular channel flow = 122.778(CFS)
Irregular channel normal depth above invert elev. = 0.986(Ft.)
Average velocity of channel(s) = 11.426(Ft/s)

Sub-Channel No. 2 Critical depth = 1.531(Ft.)
' ' ' Critical flow top width = 23.775(Ft.)
' ' ' Critical flow velocity= 5.474(Ft/s)
' ' ' Critical flow area = 22.429(Sq.Ft)

++++++

**PRELIMINARY HYDROLOGY STUDY
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COUNTY OF SAN DIEGO, NEAR ESCONDIDO, CA**

SECTION 9

CIVILCADD/CIVILDESIGN Engineering Software, (c) 2004 Version 7.0

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*** Irregular Channel Analysis ***

Upstream (headworks) Elevation = 527.000(Ft.)
Downstream (outlet) Elevation = 507.000(Ft.)
Runoff/Flow Distance = 390.000(Ft.)
Maximum flow rate in channel(s) = 127.778(CFS)

Depth of flow = 0.797(Ft.)
Average velocity = 12.019(Ft/s)
Total flow rate in 1/2 street = 127.778(CFS)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
| 1 | 0.00 | 5.00 |
| 2 | 3.09 | 4.00 |
| 3 | 6.16 | 3.00 |
| 4 | 9.38 | 2.00 |
| 5 | 12.61 | 1.00 |
| 6 | 15.83 | 0.00 |
| 7 | 25.08 | 0.00 |
| 8 | 32.13 | 1.00 |
| 9 | 35.86 | 2.00 |
| 10 | 39.60 | 3.00 |
| 11 | 43.33 | 4.00 |
| 12 | 47.07 | 5.00 |

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 127.778(CFS)
' ' flow top width = 17.434(Ft.)
' ' wetted perimeter = 17.611(Ft.)
' ' velocity= 12.019(Ft/s)
' ' area = 10.632(Sq.Ft)
' ' Froude number = 2.712

Upstream point elevation = 527.000(Ft.)
Downstream point elevation = 507.000(Ft.)
Flow length = 390.000(Ft.)
Depth of flow = 0.797(Ft.)
Average velocity = 12.019(Ft/s)
Total irregular channel flow = 127.778(CFS)
Irregular channel normal depth above invert elev. = 0.797(Ft.)
Average velocity of channel(s) = 12.019(Ft/s)

Sub-Channel No. 1 Critical depth = 1.391(Ft.)
' ' ' Critical flow top width = 22.239(Ft.)
' ' ' Critical flow velocity= 5.669(Ft/s)
' ' ' Critical flow area = 22.541(Sq.Ft)

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SECTION 10

CIVILCADD/CIVILDESIGN Engineering Software, (c) 2004 Version 7.0

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*** Irregular Channel Analysis ***

Upstream (headworks) Elevation = 527.000(Ft.)
Downstream (outlet) Elevation = 507.000(Ft.)
Runoff/Flow Distance = 390.000(Ft.)
Maximum flow rate in channel(s) = 127.778(CFS)

Depth of flow = 0.547(Ft.)
Average velocity = 10.796(Ft/s)
Total flow rate in 1/2 street = 127.778(CFS)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
| 1 | 0.00 | 5.00 |
| 2 | 1.89 | 4.00 |
| 3 | 3.79 | 3.00 |
| 4 | 5.57 | 2.00 |
| 5 | 7.33 | 1.00 |
| 6 | 9.08 | 0.00 |
| 7 | 29.56 | 0.00 |
| 8 | 32.00 | 1.00 |
| 9 | 34.43 | 2.00 |
| 10 | 36.87 | 3.00 |
| 11 | 39.31 | 4.00 |
| 12 | 41.75 | 5.00 |

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 127.779(CFS)
' ' flow top width = 22.773(Ft.)
' ' wetted perimeter = 23.026(Ft.)
' ' velocity= 10.796(Ft/s)
' ' area = 11.835(Sq.Ft)
' ' Froude number = 2.639

Upstream point elevation = 527.000(Ft.)
Downstream point elevation = 507.000(Ft.)
Flow length = 390.000(Ft.)
Depth of flow = 0.547(Ft.)
Average velocity = 10.796(Ft/s)
Total irregular channel flow = 127.778(CFS)
Irregular channel normal depth above invert elev. = 0.547(Ft.)
Average velocity of channel(s) = 10.796(Ft/s)

Sub-Channel No. 1 Critical depth = 1.031(Ft.)
' ' ' Critical flow top width = 24.801(Ft.)
' ' ' Critical flow velocity= 5.473(Ft/s)
' ' ' Critical flow area = 23.348(Sq.Ft)

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SECTION 11

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*** Irregular Channel Analysis ***

Upstream (headworks) Elevation = 527.000(Ft.)
Downstream (outlet) Elevation = 507.000(Ft.)
Runoff/Flow Distance = 390.000(Ft.)
Maximum flow rate in channel(s) = 127.778(CFS)

Depth of flow = 0.405(Ft.)
Average velocity = 8.923(Ft/s)
Total flow rate in 1/2 street = 127.778(CFS)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
| 1 | 0.00 | 3.00 |
| 2 | 4.77 | 2.00 |
| 3 | 9.70 | 1.00 |
| 4 | 14.63 | 0.00 |
| 5 | 48.34 | 0.00 |
| 6 | 51.46 | 1.00 |
| 7 | 54.43 | 2.00 |
| 8 | 57.40 | 3.00 |

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 127.778(CFS)
' ' flow top width = 36.972(Ft.)
' ' wetted perimeter = 37.076(Ft.)
' ' velocity= 8.923(Ft/s)
' ' area = 14.319(Sq.Ft)
' ' Froude number = 2.527

Upstream point elevation = 527.000(Ft.)
Downstream point elevation = 507.000(Ft.)
Flow length = 390.000(Ft.)
Depth of flow = 0.405(Ft.)
Average velocity = 8.923(Ft/s)
Total irregular channel flow = 127.778(CFS)
Irregular channel normal depth above invert elev. = 0.405(Ft.)
Average velocity of channel(s) = 8.923(Ft/s)

Sub-Channel No. 1 Critical depth = 0.742(Ft.)
' ' ' Critical flow top width = 39.685(Ft.)
' ' ' Critical flow velocity= 4.691(Ft/s)
' ' ' Critical flow area = 27.236(Sq.Ft)

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SECTION 12

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*** Irregular Channel Analysis ***

Upstream (headworks) Elevation = 517.000(Ft.)
Downstream (outlet) Elevation = 507.000(Ft.)
Runoff/Flow Distance = 390.000(Ft.)
Maximum flow rate in channel(s) = 127.778(CFS)

Depth of flow = 0.405(Ft.)
Average velocity = 6.350(Ft/s)
Total flow rate in 1/2 street = 127.778(CFS)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
| 1 | 0.00 | 3.00 |
| 2 | 5.22 | 2.00 |
| 3 | 10.45 | 1.00 |
| 4 | 15.87 | 0.00 |
| 5 | 63.65 | 0.00 |
| 6 | 67.47 | 1.00 |
| 7 | 71.27 | 2.00 |
| 8 | 75.07 | 3.00 |

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 127.778(CFS)
' ' flow top width = 51.525(Ft.)
' ' wetted perimeter = 51.614(Ft.)
' ' velocity= 6.350(Ft/s)
' ' area = 20.124(Sq.Ft)
' ' Froude number = 1.791

Upstream point elevation = 517.000(Ft.)
Downstream point elevation = 507.000(Ft.)
Flow length = 390.000(Ft.)
Depth of flow = 0.405(Ft.)
Average velocity = 6.350(Ft/s)
Total irregular channel flow = 127.778(CFS)
Irregular channel normal depth above invert elev. = 0.405(Ft.)
Average velocity of channel(s) = 6.350(Ft/s)

Sub-Channel No. 1 Critical depth = 0.594(Ft.)
' ' Critical flow top width = 53.266(Ft.)
' ' Critical flow velocity= 4.260(Ft/s)
' ' Critical flow area = 29.998(Sq.Ft)

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SECTION 13

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*** Irregular Channel Analysis ***

Upstream (headworks) Elevation = 507.000(Ft.)
Downstream (outlet) Elevation = 499.000(Ft.)
Runoff/Flow Distance = 200.000(Ft.)
Maximum flow rate in channel(s) = 134.800(CFS)

Depth of flow = 0.785(Ft.)
Average velocity = 9.492(Ft/s)
Total flow rate in 1/2 street = 134.800(CFS)
***** Irregular Channel Data *****

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|--------------|----------------|----------------|
| 1 | 0.00 | 5.00 |
| 2 | 12.26 | 4.00 |
| 3 | 24.51 | 3.00 |
| 4 | 36.77 | 2.00 |
| 5 | 49.02 | 1.00 |
| 6 | 54.91 | 0.52 |
| 7 | 69.58 | 0.00 |
| 8 | 77.88 | 0.21 |
| 9 | 79.89 | 1.00 |
| 10 | 82.42 | 2.00 |
| 11 | 84.95 | 3.00 |
| 12 | 87.47 | 4.00 |
| 13 | 90.00 | 5.00 |

Manning's 'N' friction factor = 0.020

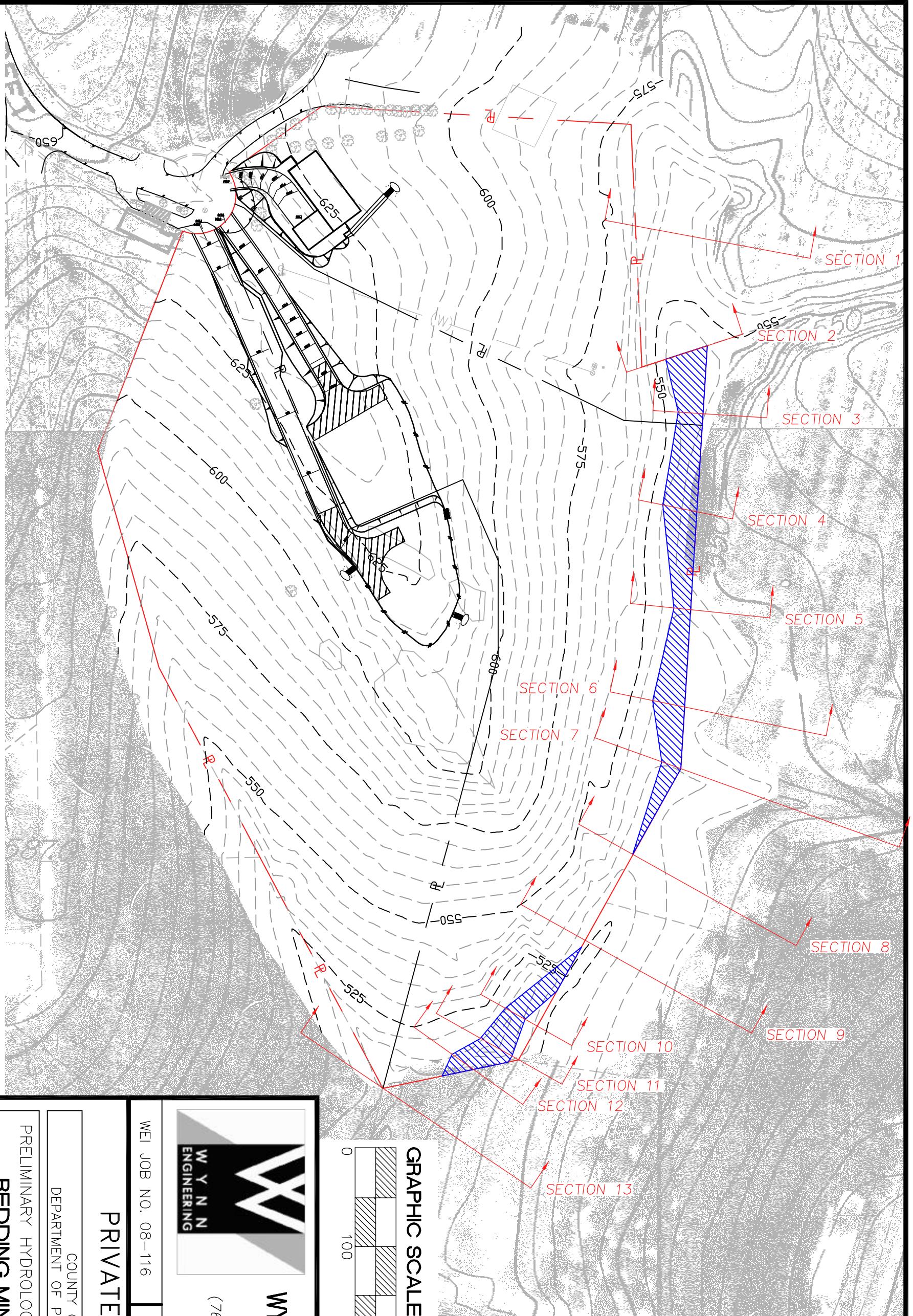
Sub-Channel flow = 134.801(CFS)
' ' flow top width = 27.687(Ft.)
' ' wetted perimeter = 27.819(Ft.)
' ' velocity= 9.492(Ft/s)
' ' area = 14.202(Sq.Ft)
' ' Froude number = 2.336

Upstream point elevation = 507.000(Ft.)
Downstream point elevation = 499.000(Ft.)
Flow length = 200.000(Ft.)
Depth of flow = 0.785(Ft.)
Average velocity = 9.492(Ft/s)
Total irregular channel flow = 134.800(CFS)
Irregular channel normal depth above invert elev. = 0.785(Ft.)
Average velocity of channel(s) = 9.492(Ft/s)

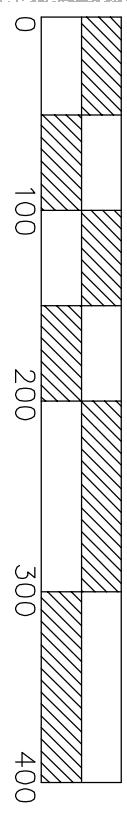
Sub-Channel No. 1 Critical depth = 1.188(Ft.)
' ' ' Critical flow top width = 33.641(Ft.)
' ' ' Critical flow velocity= 5.079(Ft/s)
' ' ' Critical flow area = 26.540(Sq.Ft)



APPROXIMATE 100-YEAR INUNDATION AREA



GRAPHIC SCALE



WYNN ENGINEERING, INC.

27315 VALLEY CENTER ROAD
VALLEY CENTER, CA. 92082
(760) 749-8722 (310) 306-9728
FAX (760) 749-9412

| | | |
|--|--------------|-------|
| WEI JOB NO. 08-116 | 3/4/09 | B-239 |
| COUNTY OF SAN DIEGO
DEPARTMENT OF PLANNING AND LAND USE | | |
| PRELIMINARY HYDROLOGY EXHIBIT FOR: | | |
| REDDING MINOR SUBDIVISION | | |
| TPM 2112 | | |
| 100-YEAR INUNDATION | | |
| SHEET: 1 | OF SHEETS: 1 | |



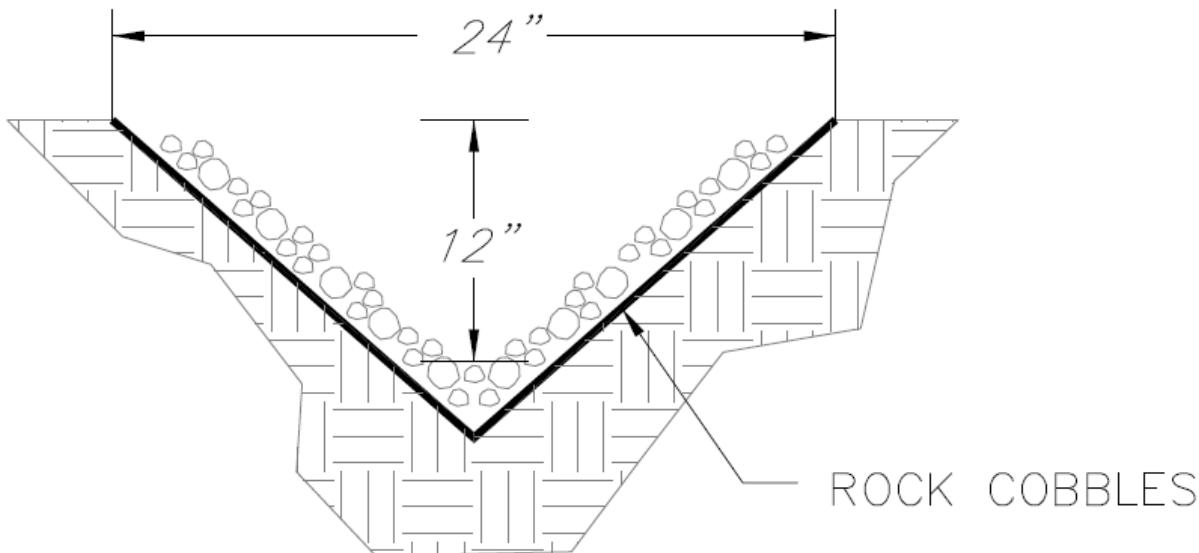
**PRELIMINARY HYDROLOGY STUDY
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ATTACHMENT 6: WATER QUALITY CALCULATIONS

This attachment contains Water Quality Calculations associated with the water quality treatment control and/or conveyance components of the Stormwater Management Plan. The following are AutoCAD calculation output summaries based on the Proposed Conditions Calculations in Attachment 3.

CHANNEL SECTIONS

There are three different channel configurations that will be used on the project site. There are two vegetated swale and one rock line swale configurations. The sections of each are as follows:

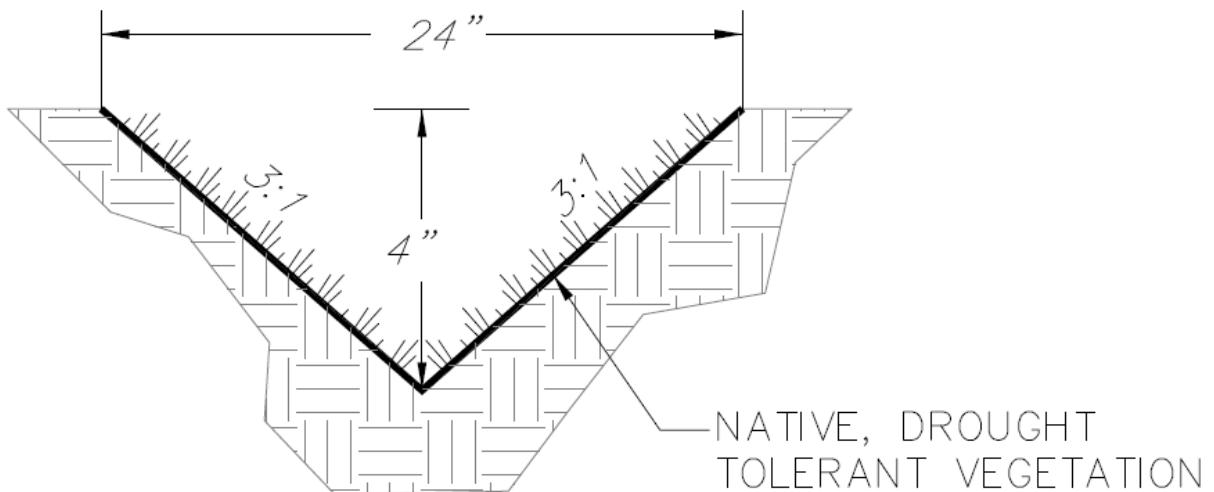


ROCK COBBLE NOTE:

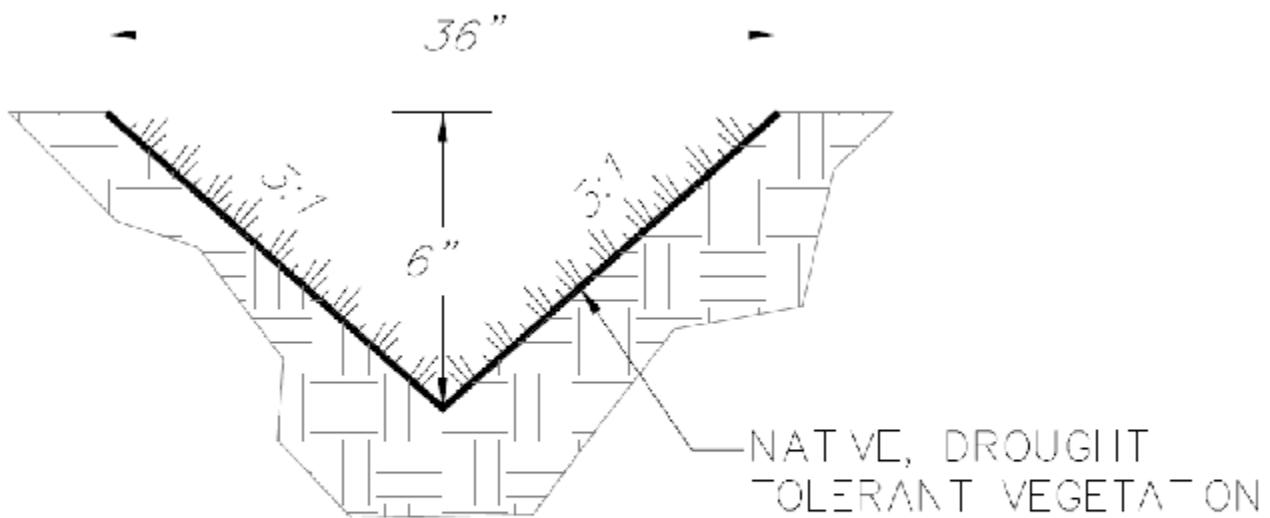
ROCK COBBLES TO CONFORM TO A MINIMUM ROCK GRADATION OF #2 BACKING PER TABLE 5-3 OF THE C.O.S.D. DRAINAGE DESIGN MANUAL

SECTION A-A: ROCK LINED
DRAINAGE SWALE
N.T.S.

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SECTION B-B: VEGETATED SWALE
N.T.S.



SECTION C-C: VEGETATED SWALE
N.T.S.

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CHANNEL A – VEGETATED SWALE

Q_{WC} Water Quality Discharge (85th Percentile)

$$\begin{aligned} Q_{WC} &= (C) \times (I_{85th}) \times (A) \\ &= 0.36 \times 0.20 \times 0.12 \\ &= 0.009 \text{ cfs} \end{aligned}$$

Base Channel Information from AutoCAD Software:

Channel Calculator

Given Input Data:

Shape Trapezoidal
Solving for Depth of Flow
Flowrate 0.0090 cfs
Slope 0.0250 ft/ft
Manning's n 0.0250
Height 4.0000 in
Bottom width 0.0000 in
Left slope 0.3300 ft/ft (V/H)
Right slope 0.3300 ft/ft (V/H)

Computed Results:

Depth 0.7038 in
Velocity 0.8635 fps
Full Flowrate 0.9259 cfs
Flow area 0.0104 ft²
Flow perimeter 4.4916 in
Hydraulic radius 0.3342 in
Top width 4.2654 in
Area 0.3367 ft²
Perimeter 25.5283 in
Percent full 17.5947 %

Critical Information

Critical depth 0.6714 in
Critical slope 0.0321 ft/ft
Critical velocity 0.9487 fps
Critical area 0.0095 ft²
Critical perimeter 4.2850 in
Critical hydraulic radius 0.3188 in
Critical top width 4.0692 in
Specific energy 0.0702 ft
Minimum energy 0.0839 ft
Froude number 0.8889
Flow condition Subcritical

Residence Time: = Length of Swale / Velocity of Swale
= 100 feet / 0.8635 fps
= 115.81 sec
= 1.93 minutes

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CHANNEL B – ROCK SWALE (#2 BACKING)

Q_{WC} Water Quality Discharge (85th Percentile)

$$\begin{aligned} Q_{WC} &= (C) \times (I_{85th}) \times (A) \\ &= 0.36 \times 0.20 \times 0.21 \\ &= 0.015 \text{ cfs} \end{aligned}$$

Base Channel Information from AutoCAD Software:

Channel Calculator

Given Input Data:

Shape Trapezoidal
Solving for Depth of Flow
Flowrate 0.0150 cfs
Slope 0.2000 ft/ft
Manning's n 0.0370
Height 12.0000 in
Bottom width 0.0000 in
Left slope 1.0000 ft/ft (V/H)
Right slope 1.0000 ft/ft (V/H)

Computed Results:

Depth 1.0908 in
Velocity 1.8155 fps
Full Flowrate 8.9805 cfs
Flow area 0.0083 ft²
Flow perimeter 3.0851 in
Hydraulic radius 0.3856 in
Top width 2.1815 in
Area 1.0000 ft²
Perimeter 33.9411 in
Percent full 9.0896 %

Critical Information

Critical depth 1.2833 in
Critical slope 0.0840 ft/ft
Critical velocity 1.3116 fps
Critical area 0.0114 ft²
Critical perimeter 3.6297 in
Critical hydraulic radius 0.4537 in
Critical top width 2.5666 in
Specific energy 0.1421 ft
Minimum energy 0.1604 ft
Froude number 1.5014
Flow condition Supercritical

Residence Time: = Length of Swale / Velocity of Swale
= 60 feet / 1.8155 fps
= 33.05 sec
= 0.56 minutes*

* This swale is a Rock Lined Channel; therefore, residence time does not matter

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CHANNEL C – VEGETATED SWALE

Q_{WC} Water Quality Discharge (85th Percentile)

$$\begin{aligned} Q_{WC} &= (C) \times (I_{85th}) \times (A) \\ &= 0.36 \times 0.20 \times 0.41 \\ &= 0.030 \text{ cfs} \end{aligned}$$

Base Channel Information from AutoCAD Software:

Channel Calculator

Given Input Data:

Shape Trapezoidal
Solving for Depth of Flow
Flowrate 0.0300 cfs
Slope 0.0100 ft/ft
Manning's n 0.0250
Height 4.0000 in
Bottom width 0.0000 in
Left slope 0.3300 ft/ft (V/H)
Right slope 0.3300 ft/ft (V/H)

Computed Results:

Depth 1.3126 in
Velocity 0.8274 fps
Full Flowrate 0.5856 cfs
Flow area 0.0363 ft²
Flow perimeter 8.3771 in
Hydraulic radius 0.6232 in
Top width 7.9552 in
Area 0.3367 ft²
Perimeter 25.5283 in
Percent full 32.8151 %

Critical Information

Critical depth 1.0868 in
Critical slope 0.0274 ft/ft
Critical velocity 1.2070 fps
Critical area 0.0249 ft²
Critical perimeter 6.9359 in
Critical hydraulic radius 0.5160 in
Critical top width 6.5865 in
Specific energy 0.1200 ft
Minimum energy 0.1358 ft
Froude number 0.6238
Flow condition Subcritical

Residence Time: = Length of Swale / Velocity of Swale
= 350 feet / 0.8274 fps
= 423.01 sec
= 7.05 minutes

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CHANNEL D – VEGETATED SWALE

Q_{WC} Water Quality Discharge (85th Percentile)

$$\begin{aligned} Q_{WC} &= (C) \times (I_{85th}) \times (A) \\ &= 0.36 \times 0.20 \times 0.41 \\ &= 0.030 \text{ cfs} \end{aligned}$$

Base Channel Information from AutoCAD Software:

Channel Calculator

Given Input Data:

Shape Trapezoidal
Solving for Depth of Flow
Flowrate 0.0300 cfs
Slope 0.0090 ft/ft
Manning's n 0.0250
Height 6.0000 in
Bottom width 0.0000 in
Left slope 0.3300 ft/ft (V/H)
Right slope 0.3300 ft/ft (V/H)

Computed Results:

Depth 1.3388 in
Velocity 0.7954 fps
Full Flowrate 1.6379 cfs
Flow area 0.0377 ft²
Flow perimeter 8.5443 in
Hydraulic radius 0.6357 in
Top width 8.1139 in
Area 0.7576 ft²
Perimeter 38.2925 in
Percent full 22.3132 %

Critical Information

Critical depth 1.0868 in
Critical slope 0.0274 ft/ft
Critical velocity 1.2070 fps
Critical area 0.0249 ft²
Critical perimeter 6.9359 in
Critical hydraulic radius 0.5160 in
Critical top width 6.5865 in
Specific energy 0.1214 ft
Minimum energy 0.1358 ft
Froude number 0.5937
Flow condition Subcritical

Residence Time: = Length of Swale / Velocity of Swale
= 100 feet / 0.7954 fps
= 125.72 sec
= 2.09 minutes

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CHANNEL E – ROCK SWALE (#2 BACKING)

Q_{WC} Water Quality Discharge (85th Percentile)

$$\begin{aligned} Q_{WC} &= (C) \times (I_{85th}) \times (A) \\ &= 0.36 \times 0.20 \times 0.59 \\ &= 0.043 \text{ cfs} \end{aligned}$$

Base Channel Information from AutoCAD Software:

Channel Calculator

Given Input Data:

Shape Trapezoidal
Solving for Depth of Flow
Flowrate 0.0430 cfs
Slope 0.0470 ft/ft
Manning's n 0.0370
Height 12.0000 in
Bottom width 0.0000 in
Left slope 1.0000 ft/ft (V/H)
Right slope 1.0000 ft/ft (V/H)

Computed Results:

Depth 2.1241 in
Velocity 1.3724 fps
Full Flowrate 4.3535 cfs
Flow area 0.0313 ft²
Flow perimeter 6.0078 in
Hydraulic radius 0.7510 in
Top width 4.2481 in
Area 1.0000 ft²
Perimeter 33.9411 in
Percent full 17.7006 %

Critical Information

Critical depth 1.9556 in
Critical slope 0.0730 ft/ft
Critical velocity 1.6191 fps
Critical area 0.0266 ft²
Critical perimeter 5.5312 in
Critical hydraulic radius 0.6914 in
Critical top width 3.9111 in
Specific energy 0.2063 ft
Minimum energy 0.2444 ft
Froude number 0.8133
Flow condition Subcritical

Residence Time: = Length of Swale / Velocity of Swale
= 275 feet / 1.3724 fps
= 200.38 sec
= 3.34 minutes*

* This swale is a Rock Lined Channel; therefore, residence time does not matter

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CHANNEL F – VEGETATED SWALE

Q_{WC} Water Quality Discharge (85th Percentile)

$$\begin{aligned} Q_{WC} &= (C) \times (I_{85th}) \times (A) \\ &= 0.36 \times 0.20 \times 0.25 \\ &= 0.018 \text{ cfs} \end{aligned}$$

Base Channel Information from AutoCAD Software:

Channel Calculator

Given Input Data:

Shape Trapezoidal
Solving for Depth of Flow
Flowrate 0.0180 cfs
Slope 0.0100 ft/ft
Manning's n 0.0250
Height 4.0000 in
Bottom width 0.0000 in
Left slope 0.3300 ft/ft (V/H)
Right slope 0.3300 ft/ft (V/H)

Computed Results:

Depth 1.0838 in
Velocity 0.7282 fps
Full Flowrate 0.5856 cfs
Flow area 0.0247 ft²
Flow perimeter 6.9168 in
Hydraulic radius 0.5146 in
Top width 6.5684 in
Area 0.3367 ft²
Perimeter 25.5283 in
Percent full 27.0945 %

Critical Information

Critical depth 0.8859 in
Critical slope 0.0293 ft/ft
Critical velocity 1.0898 fps
Critical area 0.0165 ft²
Critical perimeter 5.6541 in
Critical hydraulic radius 0.4207 in
Critical top width 5.3693 in
Specific energy 0.0986 ft
Minimum energy 0.1107 ft
Froude number 0.6042
Flow condition Subcritical

Residence Time: = Length of Swale / Velocity of Swale
= 110 feet / 0.7282 fps
= 151.06 sec
= 2.52 minutes